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Science in World Affairs

IN recent broadcast addresses, Mr. Neville Chamberlain and President Roosevelt have pleaded for peace among civilized peoples by consultation instead of force—whether displayed to produce fear or actually used to oppress or subjugate races or nationalities. In the speech which the Prime Minister broadcast at the darkest hour of the recent crisis, he affirmed his conviction that any nation which attempted to dominate the world by fear of its force should be resisted, and that under such a domination the life of people who believe in liberty would not be worth living. President Roosevelt stated very clearly the basic principles of permanent peace by which alone can we hope for scientific or any other quality of human progress. "There can be no peace," he said, "if the reign of law is to be replaced by a recurrent sanctification of sheer force. There can be no peace if national policy adopts as a deliberate instrument the dispersion all over the world of millions of helpless, persecuted wanderers with no place to lay their heads. There can be no peace if men and women are not free to think their own thoughts, to express their own feelings, and to worship God. There can be no peace if economic resources which should be devoted to economic reconstruction are to be diverted to intensified competition in armaments—to a competition which will merely heighten suspicions and fears and threaten the economic prosperity of each and every nation."

It is obvious that the spirit of this declaration is opposed to the urge of nationalism which is now the chief cause of conflicting policies. Any nation which separates itself from the rest of the world in the name of race or religion, and cultivates ideals of conquest by force in order to impose its beliefs upon others, is not promoting social or ethical evolution but retarding it. Science has made the world a single unit through the facilities of communication and transport now available, and it recognizes no political or racial boundaries in its fields of knowledge. To limit study or research in science to any national or racial group, and to disregard other contributions to the progress of natural knowledge, is to betray all that is best in scientific intention. Among modern and social intellectual forces, science alone speaks in a tongue which meets with universal understanding: if it should ever consent to be coerced into a purely nationalistic policy its suicide is inevitable.

What is wanted to-day is the international spirit of science in the consideration of problems in which the interests of several nations are involved. This, as is suggested in a letter signed by the Archbishop of York, the Bishop of Bristol, Sir Gowland Hopkins, Sir Thomas Holland, Sir Frederic Kenyon, Sir Richard Gregory, Mr. H. G. Wells, and others, published in *The Times* of October 29, is the kind of moral rearmament to which attention should be given by all statesmen if rationalism instead of nationalism is to be an effective power in shaping the destiny of mankind. The plea made in the letter is for a World Foundation such as has been initiated in the United States by Señor de Madariaga with a two-fold purpose: (1) to foster the idea of world unity among all peoples, and (2) to promote inquiries directed towards political and economic appeasement on all fronts. These two purposes are essentially complementary. Only through a new conception of world unity can we override the rock of national bias upon which so many admirable international schemes split.

In the development of the social instinct, a sense

of consideration for the needs of others has grown from the primitive stage in which it embraced members of the blood kin only, or those of the local group within which the members are more or less intimately acquainted, to national groups, and to a commonwealth of nations. A World Foundation would embrace all to whom the dignity of man as an individual entity transcends racial and political boundaries. When such a world commonwealth extends to all men of good will, it will be possible to estimate how far the human race has advanced along the road of spiritual as well as material progress. The urge of nationalism and its ideals has diverted the thoughts of peoples in totalitarian States away from the main stream of human progress into narrower channels in which rocks and rapids threaten at every turn to shipwreck all that is best in civilization.

The efforts which scientific workers of any nationality may be expected to make in response to calls for unity and service should have for their ultimate aims a world federation and the preservation of intellectual freedom. Preparations for war, whether limited to the organization of national defence or not, cannot suffice in themselves to meet this present challenge of our day to all that is best in the heritage of mankind. The call which Dr. E. C. Conklin addressed to the American Association for the Advancement of Science last December, that those who inherit the tradition of liberty of thought, speech and Press, and believe that it is essential to all progress, should use their utmost influence to see that intellectual freedom shall not perish from the earth, has but gained in cogency from events that have since taken place.

Such freedom is still essential for the advance of science, and scientific workers to-day may well feel even more than a year ago that the time has come when science should stand openly for freedom, especially in countries where force, war and civil disabilities leading to exile are used to compel acceptance of political or social creeds. The growing restriction of intellectual liberty is, indeed, the most disturbing feature of the present international situation. From many sources before and as well as after the recent crisis have come appeals to rally in defence of liberty, and scientific workers have more rather than less reason than the ordinary citizen to respond to that appeal. Science is everywhere the same in aims and methods. Its advance has depended on the contributions of individual inquirers without distinction of race, and anything that limits their contribution or hinders the exchange of views or the contact between different workers impedes that advance.

The greatest problems that confront mankind to-day—the promotion of social co-operation, justice and brotherhood, the upholding and development of loyalty to truth, and the expansion of ethics until it embraces all mankind, are problems which intimately concern science, which indeed must bring its own contribution to their solution. There is, however, an even greater challenge. Such problems can only be solved if we zealously guard the freedom and integrity of our thought, boldly facing new conditions and meeting every problem without shrinking from difficulties, but faithful to the laws which govern our intellectual being.

It is precisely because, when freedom of thought and work in scientific research and investigation are threatened their integrity is threatened also, that the question is of such vital importance to science to-day. Unless the present contraction of liberty is checked, the threat to the advance of science and all that it implies for mankind will grow more serious. Already the free intercourse of men of science has been seriously checked, both directly and indirectly through the doubts thrown on the integrity of what purports to be scientific work in certain totalitarian States. Even in the remaining democracies the orientation of scientific work is liable to be changed and restrictions imposed, if more insidiously, on the full freedom of scientific work, through the exigencies of national defence.

With this position no scientific worker who cares seriously for the integrity of his work or the advancement of his science can rest content. Alike in the prosecution of the research directly concerned with matters of national defence, as for example, in the distribution of population or building, or in the objective study of social problems and international relations, which are a fundamental part of any policy directed to prevent or eliminate war, the principle of intellectual freedom is a vital condition. Violation of this principle injures the whole quality of the scientific contribution and may ultimately destroy it, while at the same time it hinders the wholehearted co-operation of all scientific workers which is so essential alike in the organization of national defence or a policy for peace.

The defence of intellectual freedom is thus a matter of immediate practical importance to the scientific worker, whether from the point of view of the integrity of his particular science or his response to the call for national service. He must

neglect no opportunity, either as a citizen or as a professional man, of urging support for a policy which fully safeguards such freedom and be prepared to co-operate with any national movement which aims at ensuring this essential principle of progress. He should also be prepared to accept his share in the task of rehabilitating the many men of learning whose work has been interrupted by violation of this principle in other countries. Equally he should be prepared to take his part in the clear thinking required to formulate sound principles of relations between the scientific profession and the State, and to accept loyally the discipline or code of ethics thus evolved. Nor must he fail to uphold the principle of supreme loyalty to truth, essential no less in the smallest scientific investigation than in the broad programmes of objective research into social and international problems which must be pursued if we are to build a world order from which the fear of war and the wastage of armaments is ultimately banished.

Seasonal Periodicity of Malaria

The Seasonal Periodicity of Malaria and the Mechanism of the Epidemic Wave
By Dr. Clifford Allchin Gill. Pp. xi+136. (London: J. and A. Churchill, Ltd., 1938.) 10*s.* 6*d.*

THE discovery by Ross of the mosquito cycle made it possible for the first time to explain a host of facts in the epidemiology of malaria which otherwise were entirely inexplicable. It very soon became evident that malaria, instead of being contracted from man's general surroundings in Nature, as up to then had been supposed, was merely a special case of a man-to-man infectious disease, differing only from other infectious diseases in that an intermediate insect host was required for its transmission. That the insect host was a necessary factor did not at first presuppose any very complicated relationship in this respect. If there was no vector there would naturally be no malaria; but other things being equal, the amount of malaria might be expected to be in proportion to the numerical prevalence of the incriminated insect.

This relatively simple outlook was soon found, however, to be far from an adequate one, and the history of malaria investigation has more and more shown how complex are the factors which determine malaria prevalence. Especially have recent researches shed unexpected new light in this field. In the book under notice, Colonel C. A. Gill gives a very clear and readable exposition of some of these new additions to knowledge. Malaria does not merely show different degrees of prevalence in different regions of the earth; it exhibits also peculiarities in the different terrestrial zones which can be described and defined.

It is one of the merits of this small volume that it has for the first time clearly and interestingly given both the limits and the reasons for the existence of these zones. The zones are essentially related to temperature and humidity, the different combinations and permutations of which, acting through the insect vector, the human host and the parasite, bring about special features which characterize each zone. Thus below a certain critical summer temperature, *Plasmodium falciparum* fails to make good and the field is occupied, to the virtual exclusion of other forms of the parasite, by *Plasmodium vivax*. The long-term relapse which is characteristic of this parasite not only appears to have enabled it to circumvent what would otherwise be very serious difficulties in maintaining transmission, but it also gives to malaria in the temperate malaria zone quite peculiar seasonal and other epidemiological features.

Subtropical zone malaria and tropical zone malaria differ from each other largely because, in the latter, long periods of extremely low humidity lead to decreased human immunity, so that this zone is apt to be the site of those vast epidemics which hitherto in northern India have, literally, controlled the population. These epidemics follow abnormally heavy rainfall and are terminated by the onset of a cold season. Equatorial zone malaria has its own form of epidemic which, as in the recent Ceylon epidemic, follows upon drought and not upon heavy rainfall, and possesses features due to the fact that there is no cold season to cut short its course.

All these interesting differences are very clearly set out by Colonel Gill who, proceeding from the normal to the abnormal, has been in the position to make a very valuable contribution to our knowledge of the causes and mechanism of epidemics of malaria. The book is one which all malariologists should read. S. R. C.

Sponges

Die Rohstoffe des Tierreichs

Herausgegeben von Ferdinand Pax und Walther Arndt. Lieferung 13. Kapitel 9: Schwämme. Von W. Arndt. Pp. 1577–2000. (Berlin: Gebrüder Borntraeger, 1937). 45 gold marks.

THIS is a new part of an encyclopædic work, little known as yet in Great Britain, which deals well and thoroughly with the commercial side of natural history. There is much worth knowing about beast and bird beyond the ken of even the most learned zoologist. The trapper, the fur-trader and the plumassier, the sponge-merchant and the dealer in shells, the pearl-fisher and the ivory-trader, the druggist with his fats and waxes, glues, isinglass, musk, civet, ambergris and galls, all these, not to speak of the men in Leadenhall Market or Billingsgate, are highly skilled naturalists in their own peculiar way and have a fine field of learning and observation of their own.

The volume before us, consisting of more than four hundred pages, is an extremely interesting account of the sponge fishery and the sponge market, of the many sorts of sponges known to the trade, their use and value, their place and mode of capture, and all the trade-statistics of this world-wide industry.

No man knows when sponges were first used. They were a household word in Homer's time, and Ulysses called for water and a sponge to wash down the tables and chairs after a certain sad scene in the palace. The very name is far older than Greek, and harks back to that ancient *lingua franca* of the Levantine fishermen to which *tunny* and *pinna* and the *seine*-net belong. Oppian gives a picturesque account—it might be a modern one—of the sponge-diver with a lump of lead in one hand and his crooked knife in the other, and a mouthful of oil to smooth the sea and let the sunlight through. From classical antiquity the book passes on to the trade-routes of the Middle Ages and the old Italian apothecaries' shops—and so, at last, to the sponge trade of the present day. We are shown the fine Turkey-cup or Levantine sponges, the African Zimoccas, the West-Indian grass-sponges and wire-sponges, the great elephants' ears from the Philippines, and many more; and still we are only a little way from the beginning of this interesting and useful book.

D. W. T.

Complex Osmosis

Lectures on Osmosis

By Dr. F. A. H. Schreinemakers. Pp. xi + 266. (The Hague: G. Naeff, 1938.) 8.50 gldrs.

PROF. SCHREINEMAKERS has been engaged since 1924 in studies in osmotic phenomena, which have hitherto only been available in Leyden dissertations and the publications of the Amsterdam Academy of Science. In this book he gives a collected account in English of his researches, which will be of great interest to those who are concerned with the transport of material in animal and vegetable tissues.

The fundamental equations of osmotic equilibrium were laid down by Gibbs, and provided at one time a valuable means of investigation of the properties of solutions, which has been superseded to a great extent by more convenient methods, owing to the difficulty of preparing ideally semi-permeable membranes. But ideal membranes rarely occur in Nature, and, especially in complex solutions, a baffling variety of phenomena is encountered.

This book is not concerned with the properties of solutions which determine the osmotic equilibrium, but with the effect of the membrane on the *path* by which osmotic equilibrium is approached and the different types of behaviour which may be encountered in numerous different circumstances. Thus, although osmotic flow must always proceed on the whole towards thermodynamic equilibrium, when a membrane is permeable to two or more of the substances present, it may happen that one substance is carried by another against its natural direction of osmotic flow, giving rise to apparent negative osmosis. Again, a membrane may be permeable to two substances in certain proportions; or only within a certain range of concentration. In connexion with the latter, Prof. Schreinemakers discusses some ingenious models of mechanisms by which this may be effected (checking membranes).

Although illustrative examples are given of many of the phenomena, with membranes of pig's bladder, 'Cellophane' and parchment, the book is

not primarily concerned with phenomenological aspects of the behaviour of membranes. It is to be regarded as the grammar of the subject, where all possible types of behaviour are tabulated and codified, thus providing a framework to which observed phenomena can be referred. It is not easy to read, and the severe form of the presentation may repel some, but its study by all students of membrane phenomena would be amply repaid.

Finally, we may note a point which is not generally known, namely, that in the triangular representation of ternary systems the usual equilateral triangle may be replaced by a right-angled triangle on ordinary graph paper, which has similar properties. J. A. V. Butler.

Northeastern American Marine Algæ

Marine Algæ of the Northeastern Coast of North America

By W. R. Taylor. (University of Michigan Studies, Scientific Series, Vol. 13.) Pp. ix + 427 + 60 plates. (Ann Arbor: University of Michigan Press, 1937.) 5 dollars.

RECENT handbooks dealing with the marine algæ of specific localities are few in number and no systematic account of these plants has come from North America since Farlow wrote his handbook of New England algæ more than fifty years ago. Prof. W. R. Taylor's volume describes the algæ from the Virginia capes to the arctic islands and Hudson Bay, and incorporates an incomplete manuscript left unpublished on the death of F. S. Collins in 1920. Collins's published works and especially his volume on the green algæ of North America have shown the breadth of his knowledge and experience, and it will be therefore with especial satisfaction that algologists will learn of the incorporation of his unpublished work in the present volume. Prof. Taylor makes it clear, however, that the book must not be regarded merely as a revision of Collins's manuscript, and points out the wider geographical range with which it deals.

Recent research on the marine algæ has been considerable and many new facts relative to their life-histories have been revealed, especially perhaps in the Phæophyceæ, where the mode of over-wintering of the so-called 'summer annuals' is gradually being discovered. In the Rhodophyceæ, too, our knowledge of life-histories has increased and new light has been shed on the life-cycles of aberrant forms. Such additions have their bearing on classification, and it is therefore obvious that Prof. Taylor, though using the facts incorporated in the older manuscript, was forced, in the light of recent work, to make major changes in classification and in the description of some of the life-histories.

In the present volume, some 530 species and varieties are described, and as many of them are also present in Britain, the book will be of value to algologists on this side of the Atlantic as well as to those who are working on the particular area with which the author deals. Most of the common species have been redescribed from American material, and data secured from the literature incorporated, especially in regard to life-cycles and the anatomy of reproductive organs. In addition, references are given to two exsiccatæ: Algæ Exsiccatæ Americæ Borealis by Farlow, Anderson and Eaton, and Phycotheca Boreali-Americana by Collins, Holden and Setchell. References are also made to relevant books and papers, to synonomy and to illustrations. It is of especial value to students of the subject to have references to morphological papers included in a systematic study of this kind, and this greatly enhances the general value of the work.

The author begins his volume with lists showing the geographical distribution of the commoner algæ and a brief account of algal habitats and floristic areas, together with careful notes on the collection and preservation of specimens. A brief historical survey follows, in which the history of the study of American algæ is given. This is followed by a classified list which will be of especial use as a check list to workers in other regions. Keys for orders, families, genera and species are incorporated in the descriptive catalogue, and each species is described briefly, the localities given and references cited.

In the Phæophyceæ the classification adopted appears to be that suggested by Kylin in 1934 ("Zur Kenntnis der Entwicklungsgeschichte einiger Phæophyceen." *Lunds Univ. Arsskr.* n.f. Avd., **2**, 30 (9)). It is noteworthy that there is a complete absence of any members of the Cutleriales, Dictyotales and Sporochnales in the region described. The classification puts *Acrothrix*, *Arthrocladia*, and *Desmarestia* into the Desmarestiales, thus removing *Desmarestia* from the

Laminariales where its brief sojourn, on account of the possession of a microscopic gametophyte, seemed peculiarly unsuitable on morphological grounds.

In the red algæ, recent work has been included, and the so-called parasites *Actinococcus subcutaneous* and *A. agregatus* are included in the life-histories of *Phyllophora Brodaei and Gymnogongrus Griffithsiæ*, of which they are now known to form a part.

With further reference to anomalous forms and in view of the work of Svedelius on the genus ("The apomeiotic tetrad division in *Lomentaria rosea* in comparison with the normal development in *L. clavellosa*", *Sym. Bot. Upsal.*, II, 2), it is interesting to note that *Lomentaria orcadensis* (Harvey) Collins is recorded only with tetraspores. The investigation of the nuclear condition of this plant would be of especial interest.

The book is illustrated by sixty plates drawn by Chin Chih Jao, whose skill and algological knowledge have combined to produce illustrations of a very high order. The drawings of external morphology are especially delightful and those drawn at high magnification combine accuracy of interpretation with beauty of line. It is perhaps less convenient to have the illustrations at the end rather than inserted in the text, but doubtless there were technical reasons for the decision. For the benefit of those who are not very familiar with the region, a map showing the general distribution of the algæ would have been helpful and could easily have been constructed from the data given.

An extensive bibliography completes a volume that will be welcomed by algologists as a systematic handbook of a new and particularly pleasing kind. L. N.

Statistical Theory

Simplified Statistics

By Leonard J. Holman. Pp. xii + 142. (London: Sir Isaac Pitman and Sons, Ltd., 1938.) 3*s*. 6*d*. net.

IN recent years it has been widely recognized that a knowledge of statistical theory is not only important in the sciences, but is also of great usefulness in many fields of business and commerce. Courses on statistics are now given in various commercial colleges, and the subject is finding a recognized place in any well-balanced commercial curriculum. These developments have already called forth a number of suitable text-books in which the subject is approached in a simpler and more practical way than in the earlier books, where statistics was treated for the most part as a branch of mathematics.

The regular student having been thus catered for, the question arises whether it is possible to present statistical theory to the general public. For this, a still simpler and more attractive treatment is needed; and it is such a presentation that the author has provided in this volume. In his preface he enumerates the classes of readers for whom he has written. Some people are in the habit of using statistical formulæ without having the least idea how the formulæ have been derived. There are others who at one time made an effort to study statistical theory, but, coming up against a mass of algebraic formulæ, abandoned the attempt. But the general public is for the most part unaware that there is a theory of statistics, and understands by the word 'statistics' nothing but the lists of figures in official records, such as census and trade returns. Such readers, if they have an aptitude for mathematics, and are interested in the derivation of formulæ, will in this book learn of the underlying laws, and of the connexion of these with mathematical probability. The examples are well chosen from everyday life; the author not only considers the monthly fluctuation in the sales of a commodity, but also discusses in detail how one would set about verifying such propositions as "Smoking during youth inhibits growth" and "Brunettes are more excitable than blondes".

In places the author has not succeeded in smoothing the reader's path. At the very beginning of the book, the reader is confronted with a diagram consisting of three large rectangles and a few smaller rectangles. The diagram looks like the floor-plan of a house, and the beginner may be astonished to find that, without warning, the rectangles are referred to as a curve, in fact a bell-shaped curve. The author has overlooked the fact that, to the inexperienced eye, rectangles do not look like a curve. On the whole, however, the author has taken great trouble to make each step clear, and sometimes to cheer the reader on his way with jocularity in the style of a news-reel commentator. The nature of statistical theory is such that the non-mathematical reader can scarcely expect to follow the details of the argument without unusual perseverance; but to any who wish to 'try their strength', the book can be sincerely recommended. R. W. G.

Die Sedimente des äquatorialen Atlantischen Ozeans
Lief. 2: C. Zusammenstellung der Untersuchungsergebnisse nach Stationen geordnet; D. Auswertung der Ergebnisse. Von Prof. Dr. Carl W. Correns; mit Beiträgen von V. Leinz und O. E. Radczewski. (Wissenschaftliche Ergebnisse der deutschen Atlantischen Expedition auf dem Forschungs- und Vermessungsschiff *Meteor* 1925–1927, herausgegeben im Auftrage der Notgemeinschaft der deutschen Wissenschaft von Prof. Dr. Albert Defant, Band 3, Teil 3.) Pp. xii+135–298. (Berlin: Walter de Gruyter und Co., 1937.) 20 gold marks.

IN this report, Dr. Correns gives the result of the mechanical, mineralogical, chemical and microscopic examination of more than a hundred specimens of the bottom deposits from the equatorial parts of the Atlantic Ocean. The larger number of these were cores obtained with a sampler of the Ekman type, and the longest measured 95 cm. When the core consisted of more than one part, each part was examined separately, and in nearly every case it was possible to assign it to its period, glacial, interglacial or post-glacial. An interesting result of this is that it is shown that in glacial times fine sand blew seawards from northern Africa as it does now from the Sahara.

The mineral components of the various types of deposit are found to be much more uniform than was supposed previously; the minerals occurring in blue mud, Globerigina ooze and red clay are strikingly similar. Special attention was paid to the content of calcium carbonate, which is of great interest in view of Wattenberg's investigations into the conditions under which it is dissolved by the bottom water. In the deep sea it is chiefly foraminiferous, and W. Schott has found that the sieve fraction No. 2, with a particle radius of 1·0–0·1 mm., consists almost entirely of foraminifera. He uses this weight to calculate the 'foraminifera number' of the deposit.

Dr. Correns sees in the deep sea deposits of the equatorial Atlantic Ocean a transition from blue mud with rapid sedimentation of the mineral components, by way of the calcareous clays and Globerigina ooze to the red clay, in which the finest minerals fall slowly to the bottom while the calcium carbonate is redissolved.

Fortschritte der Paläontologie
Herausgegeben von O. H. Schwindewolf. Band 1: Bericht über die Jahre 1935 und 1936. Pp. viii+374. (Berlin: Gebrüder Borntraeger, 1937.) 29.60 gold marks.

THIS new periodical is intended to form a biennial review of the progress of palæontology. It was planned with the idea that it should serve to keep up to date the "Handbuch der Paläozoologie", but the publication of that work was delayed and the first part has only recently appeared.

The arrangement of the volume is similar to that of the *Palaeontologisches Zentralblatt*. It begins with sections on text-books, phylogeny, palæogeography, zoogeography and other general subjects, followed by sections on different groups of fossils, each written by someone with a special knowledge of the group and concluded with a select bibliography. Each section aims at giving a summary of the more important work published in the years 1935 and 1936. With so many authors there must necessarily be some want of uniformity in both the character and the amount of information given; moreover, the quality and amount of research done must vary in different groups, so that some sections of the volume lend themselves to more interesting treatment than others.

The periodical should be of great value to advanced students and to specialists who wish to keep in touch with the work which is being done in other fields of palæontology.

Heredity
By Prof. A. Franklin Shull. (McGraw-Hill Publications in the Zoological Sciences.) Third edition. Pp. xvii + 442 + 1 plate. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 21*s*.

THIS book has been largely rewritten in the present edition. Its contents are still concerned mainly with the genetics of cultivated plants, domesticated animals and man. The human side has been considerably extended, and the order of the chapters rearranged. Chapters are included on eugenics, population, race problems and immigration.

The book is intended as an introductory statement on genetics for first-year students in American universities who have had no previous training in biology and are taking up the subject from the general cultural point of view. It contains much that would be of interest to the general reader and should help the student to orientate himself regarding the bearing of genetics on human affairs. The quantitative or biometric side of genetics is treated in an appendix of twelve pages. This is followed by a series of 660 "questions and problems" based on the text, a list of literature and an index. No typographical errors were noticed, but Fig. 34 A, from another text-book, gives a misleading conception of the relative size of the parts in a flower bud.

La Vie des mouches et des moustiques
Par E. Séguy. (Bibliothèque Juventa.) Pp. 254+12 plates. (Paris: Librairie Delegrave, 1938.) 16 francs.

M. SÉGUY, the author of this manual, is a well-known student and writer on the Diptera. The book, therefore, is authoritative although essentially non-technical. Written in a clear style, it conveys to the general reader the latest essential information regarding flies and mosquitoes, their habits and, more especially, their relations with man. The title of the book does not really convey the idea of its main purpose, which is to disseminate knowledge of the great economic importance of this order of insects. It deals in special with the relations of Diptera to human and animal disease, whether it be caused by the larvæ (myiasis) or brought about by the adult flies as vectors. The book is illustrated by numerous figures combined into 12 plates which are drawn by the author. It deserves a good reception, not only in France, but in other lands also.

A. D. I.

Swedenborg's Treatise on Copper

THE circumstances in which a translation of Swedenborg's historic "Treatise on Copper" has become available to the public are indicated in a preface to the edition recently published*, written by Mr. Fullman, editor and information officer of the British Non-Ferrous Metals Research Association. He writes:

"In 1734 Emanuel Swedenborg, the Swedish Scientist, Philosopher and Mystic, published the three volumes of his Latin Treatise 'Opera Philosophica et Mineralia'. The first volume contains a mechanical and geometrical theory of the origin of things: a translation was published by the Rev. Augustus Clissold under the title 'The Principia or the First Principles of Natural Things', (London 1846. 2 volumes). The second volume deals with iron and steel and has been translated into French and Swedish: a long review of the Swedish translation by Harald Carlborg appeared in 'The New Philosophy', April 1926, Vol. 29, No. 2, pp. 33–59. The third volume is concerned with copper: it is commonly known as The Treatise on Copper, or 'de Cupro', since the Latin title commences 'Regnum Subterraneum sive Minerale de Cupro et Orichalco'."

Some years ago, Mr. Fullman had occasion to check various references to the "Treatise on Copper" and, not finding any version of the book other than the original Latin, called on the Rev. J. R. Presland, librarian of the Swedenborg Society at Swedenborg House, to see if he could assist him. From him he learned that no translation of the "Treatise" had been published, but that the Society had a manuscript translation in its strong room, and also that Mr. L. P. Ford had approached Mr. A. H. Searle with a view to the translation of the original Latin, and that the work was done at Mr. Ford's expense in 1901. He offered the translation to the Council (then Committee) of the Swedenborg Society "on the condition of its undertaking to publish the work". This offer the Committee found itself unable to accept. At a meeting, held a year later, a request was received from Mr. Ford, "to preserve the English translation of Swedenborg's treatise on Copper by depositing it in their strong room". This request the Committee granted and the manuscript was shortly afterwards placed in the strong room at No. 1, Bloomsbury Street, London, from which it was transferred to Swedenborg House, Hart Street, W.C.1, when the Society moved there in 1925.

The translator, Authur Hodson Searle, was born in 1839 and died in 1914. When he was about four years old, he suffered an illness which deprived him completely of his hearing, and consequently, for a time, of speech. He was taught the finger alphabet and lip reading, and thus learned to converse, although in a somewhat muffled voice. In spite of these physical disabilities, he became an excellent Hebrew and Latin scholar. He was not a metallurgist, being in fact occupied as an artist in reproducing for the engraver plates of conchological specimens. "All in all," as Mr. Fullman writes, "his preparation of this translation is a remarkable achievement and no reader of it can fail to be impressed by its quality."

The British Non-Ferrous Metals Research Association has recently reproduced the translation in mimeograph form in three volumes, and the present reproduction makes this work, which is of great interest to metallurgists and others, readily accessible at a reasonable figure.

Swedenborg divided his "Treatise" into three parts. The first, which constitutes the great bulk of the work and is the most important, deals with the methods of smelting copper from its ores, and the refining of copper as produced in Sweden, Norway, Russia, England, Spain, Hungary, Germany, Austria and elsewhere, with notes on the same subject from treatises by various authors. The latter part of this volume contains an account of methods used for the separation of silver from copper and a discussion of brass and processes for its production. The second part commences with an account of the nature of various copper ores and their occurrence throughout the world, and then deals with the assaying of copper ore, including assaying for silver. The third and last part deals with miscellaneous matters including the production of various compounds of copper, the specific gravity of the metal and its increase of weight on oxidation.

Pride of place in the first part is given to an account of the method of roasting, smelting and refining of Fahlun ore. This was one of the greatest copper mines in the world. The author states that, at the time of publication of his book, the great mine was still unexhausted though having been continuously worked for a period of a thousand years. At the height of its fame it yielded 60,000 cwt. of copper yearly, so that, to use his words, "All its foundations, doors, grottoes,

* British Non-Ferrous Metals Research Association. Miscellaneous Publication No. 333: Swedenborg's Treatise on Copper (Opera Philosophica et Mineralia, Vol. 3). Translated into English by Arthur Hodson Searle, Section 1: Being Chapters I–XIX of Part I of Original. Pp. xviii+180. Section 2: Being Chapters XX–XLIX of Part I of Original. Pp. iii+181–348. Section 3: Being Chapters L–LIII of Part 1: Part 2 (Chapters I–IV); and Part 3 (Chapters I–XII) of Original; with Index. Pp. iv+349–536. (London: British Non-Ferrous Metals Research Association, 1938.) 25s.; to Members, 15s.

walls, porticoes, halls and columns were thrown open to their fullest extent, the ore glittering on all sides with a ruddy glow and almost blinding the eyes with rays of golden colour, so that the guests now coming from Fahlun seemed to be, as it were, introduced into the presence of Venus herself, sitting as a bride or newly-wedded wife in her most splendid decorated bridal chamber, ready to receive and welcome them most joyfully".

The extraction of copper from its ores, mainly sulphide ores, containing iron, usually with some arsenic and antimony, was a long and laborious process. Briefly, it was as follows: First there was a calcination to drive off volatiles, wood fuel being used. This was followed by fusion and smelting, in which the fuel was crushed coal, the air being blown in from a blast pipe about three inches in diameter. In this way a copper 'stone' was produced and collected in the fore-hearth, which was tapped every two hours. This stone was of an intense blood-red colour and flowed very slowly. Then followed a second calcination which consisted of six successive treatments in a 'burning fire'. The gradual removal of the volatiles took place, with accordingly an enrichment of copper. This calcination lasted about five weeks. Then came a second smelting, which occupied a further week, in which further quantities of iron were slagged off, and the cupreous product was tapped from time to time. This was known as coarse or black copper. These furnaces were situated within a mile of the mine, and there were about a hundred and thirty of them. Next followed the refining of the coarse copper at Afwedstad in Sweden, and the final stage consisted in the smelting of this so that it could be beaten out into laminæ or plates. The total period required was between seven and eight weeks and the maximum annual production was about 2,000 tons, corresponding to a weekly output of not more than 40 tons. When it is considered that the daily production of a modern copper works is of the order of 300 tons of refined metal, it will be realized that considerable advances have been made in the smelting and refining of copper in the last two hundred years.

The British Non-Ferrous Metals Research Association is to be commended for its public spirit in rendering available a treatise which gives so much information about the metallurgy of copper in the late seventeenth and early eighteenth centuries.

H. C. H. C.

Oceanography and the Fluctuations in the Abundance of Marine Animals*

By Dr. Stanley Kemp, F.R.S.

IT is interesting to note that the observations we have of salinity and temperature cannot be correlated with the biological data. For many years past, Dr. H. W. Harvey has followed the temperature and salinity changes at the western end of the Channel, and during the period since 1924 he has found that the most conspicuous movements were large incursions of low-salinity water in May 1928 and in March and April 1936, while in 1932, 1933 and 1934 (especially in 1933) patches of water with unusually high salinity moved eastwards up the Channel. So far as can be seen, these movements show no correspondence with the marked biological changes which have occurred: it is in the phosphate data only that a correlation can be found.

In the year 1921 there was an exceptional influx of Atlantic water, which filled the Channel and flooded into the North Sea. Salinity and temperature were much above normal and numbers of unusual planktonic organisms of Atlantic origin were found in the North Sea. Recent experience

(*Continued from p.* 779.)

at Plymouth might lead one to think that such an influx as this would bring benefit to the herring fisheries, but actually it was just the reverse, for at Plymouth and in the North Sea, at Lowestoft, Yarmouth, Grimsby and North Shields, the herring fishery was much below normal.

It thus appears that incursions of Atlantic water into the Channel may bring advantage to the biology of the area or may be detrimental, that no obvious connexion between the biological data and temperature and salinity is noticeable, and that so far as we can at present see, the only correlation that can be established is with phosphate. The explanation lies, I believe, in our very considerable ignorance of the constitution and origin of the water-masses which from time to time enter the Channel.

There is evidently more than one way in which an influx of Atlantic water may be advantageous. It may, in the first place, bring water with a high content of phosphate and other nutrient salts which will eventually yield an abundant plankton. Or, secondly, though deficient in phosphate, it

may bring in large quantities of phytoplankton or zooplankton, the product of a former richness in phosphate. This plankton will afford an immediate food-supply for larval fish and other animals, and when it dies down the phosphate will be regenerated and will serve for further plankton production in the future.

It is thus what we may call the biological condition of the water that is of importance, and this no doubt is to some extent determined by the season of the year. At times, in summer, the surface water may be largely devoid of both plankton and phosphate, and an influx of such water, even though its high salinity may indicate an oceanic origin, will bring no improvement to biological conditions and may indeed be harmful. In winter, when the thermocline has broken down and surface phosphate has been renewed by convection and by stormy weather, an influx may prove of advantage. But it is perhaps more probable that upwelled water, rich in the nutrient salts which are always to be found in the lower layers of the ocean, is the potent source of surface enrichment, and of the conditions in which such upwelling occurs we are very largely ignorant. We lack the necessary data and can merely speculate on what may be happening from analogy with what is known in other areas.

I have dwelt at some length on these events in the Plymouth area because they afford a good example of a long-period fluctuation and illustrate the way in which observations drawn from widely different lines of inquiry are linked together. From other sources also there is good evidence of long-period fluctuations in fisheries, and though the hydrographical changes to which they may ultimately be traced are not, as it appears, the same as in the Channel, they show that major alterations extending over a long term of years are by no means unusual.

In 1925 the Norwegians discovered great numbers of cod on the banks surrounding Bear Island, and ever since that year, except in 1929 when ice interfered with the operations, the fishery has been maintained, many trawlers visiting the banks annually to take toll of their wealth. Iverson, from whose paper my information on this fishery is derived, states that there was a former occasion when cod were plentiful in this area. That was from 1873 until 1882. Between 1883 and the time when the present fishery began, the grounds were examined on a number of occasions, but very few cod were found and the results were unprofitable. It was so in 1924, the year which preceded the present period of abundance.

Another instance is afforded by the cod fishery in West Greenland. At certain times large concentrations of cod appear on this coast and spread as far north as Disko Bay, affording a profitable fishery; but after a term of years their numbers suddenly decline and a protracted period of scarcity follows. In 1917 cod were found in West Greenland in great abundance and the fishery on this coast has been maintained up to the present day. Prior to that, as Jensen and Hansen have shown, the grounds were tested on a number of occasions without finding stocks of cod in marketable quantity; but early records indicate that there were at least two periods, in 1820 and in 1845–49, when cod were present in great numbers.

To these two instances of large-scale changes in the fish population in northern waters many others could be added, and all are apparently due to the same cause—to the fact that in recent years the entire area from Greenland to Bear Island has become appreciably warmer. Berg has collected much information on the effects of this rise in temperature, Saemundsson has given an interesting account of the alterations which have occurred in the fauna of Iceland, while Stephen has shown that marked changes have also taken place in the British marine fauna. It is clear that an increased sea-temperature, probably of the order of 1·0–2·0° C., has allowed various species of fish to extend beyond the normal limits of their distribution, with the result that it has been possible to establish productive fisheries in areas which formerly would not have yielded an adequate return. It is evident, I believe, that at some future date conditions will revert to normal, and that a time will come when these lucrative fisheries will cease to exist.

A distinction—which I believe to be a real one—can therefore be drawn between two kinds of fluctuations, both of which have a pronounced effect on the marine fauna. Normal annual fluctuations are a constant feature. They form the basis of fishery prediction, and our information, such as it is, is that their incidence is restricted: a fishery for a certain species in a particular place will be affected, while other species in the same place, or the same species in another place will be unaffected. It is to be assumed that the causes of such annual fluctuations, though of these we know but little, are also restricted both in space and in time.

In contrast are what I have called long-period fluctuations, which extend over a term of years and involve much larger areas. Such fluctuations as these are due to a widespread change in one or more of the hydrographic factors in the environment, and large numbers of species, if not all, are affected simultaneously or within a short period. Long-period fluctuations may mask the effects of the annual fluctuations and at times they will render fishery prediction unreliable.

Research in the Atlantic

Long-period fluctuations may be brought about in entirely different ways. In the Channel, as it appears, the change can be traced to a deficiency in phosphate, while in more northerly areas it is due to an increase in sea temperature. But, though there is this wide difference, the two sets of circumstances have this in common, that they originate in the open Atlantic, at the edge of the continental slope or farther to the west. It is here, in oceanic waters, that the causes of these large alterations in European fisheries must be sought.

It might be thought that a full investigation of the Atlantic drift, to which we owe so many advantages, would long since have been undertaken. Yet, to the present day, there are many problems which remain unsolved and, as Dr. Iselin has recently shown, three mutually conflicting theories are extant regarding the circulation of water in the North Atlantic. Fortunately there are signs that a period will be set to our ignorance. On the American side of the Atlantic, the Woods Hole Oceanographic Institution and the Bermuda Biological Station are collaborating in a study of the Gulf Stream and of the effect of wind velocity and direction on the strength of a current. Data recently obtained by the Woods Hole Institution show that the transport of water in the Gulf Stream has varied by as much as 20 per cent in fourteen months, and it may well be that this figure is below the normal range of variation. When the observations over the five-year period which is contemplated have been carried out, we may hope to know far more than we do at present of the Gulf Stream and its effects on circulation in the North Atlantic.

During the present year, a German research ship is making a prolonged investigation of the hydrography of the North Atlantic, and only two months ago research ships from Denmark, Norway and Scotland were co-operating with her in studying extensive areas from the Azores to Iceland.

From such combined attack we shall learn much, and there is every reason to believe that the main features of the circulation in the North Atlantic will shortly be understood. But the work in the eastern Atlantic is only an isolated set of observations, most valuable as a contribution to our knowledge of the general conditions, but affording little help in solving the problem of long-period faunistic fluctuations of which I have spoken. It is the deviations from the normal which are of paramount importance to the biologist, and it is only by repeated observations made over a series of years that they can be detected. I believe that the need for systematic oceanographic work in the eastern Atlantic will be more and more acutely felt as time goes on, and I feel convinced that it is the only way in which we can ever reach an understanding of the reasons for the large fluctuations in our fisheries.

Fisheries Research in the British Empire

There is an urgent need throughout a very large part of the British Empire for greater activity in the scientific administration of the fisheries, for to me at least it is apparent that the lessons which long years of experience have taught us in Great Britain are not generally understood elsewhere.

The plain fact is that in the Empire as a whole we are deplorably deficient in fisheries administration. To this broad statement there are of course some exceptions. By reason of its situation in Europe, the Irish Free State is obviously one of them, and it has taken its full share in the progress that has been made during the present century. Another exception is Canada, where a vigorous fisheries service, with a competent scientific staff, has been at work for many years. Newfoundland, a country to which fisheries are of predominant importance, not long since suffered a shattering blow in the loss of the whole of its laboratory buildings by fire, but it will recover from this disaster and we may hope that the work which had such a brilliantly successful beginning will shortly be resumed. Australia has now made a fresh start after the tragic loss of the *Endeavour*, and has at last taken the wise step of founding a Commonwealth fishery department. These are the high lights, and there are one or two colonies, such as the Straits Settlements and Ceylon, which give relief to what is otherwise a very sombre picture.

In South Africa, with its astonishingly rich fishing grounds and vast length of coast-line, the fishery staff is utterly inadequate, and in India, where fisheries research has immense possibilities, there is apparently little hope that proper action will be taken. In India fisheries are what is known as a transferred subject: that is to say, they have been handed over by the central Government to the provincial administrations. The result is that some provinces may have a scientific staff of one, others have none at all, while Madras, which is much the most enterprising and publishes a fisheries bulletin, has three. In such conditions fishery work on any adequate scale is clearly out of the question, and it is not possible even to begin the acquisition of the fundamental knowledge that is essential to future progress.

In almost every problem which touches marine biology it is essential to possess a background

of knowledge which can only be acquired by long years of patient study. If there is one lesson to be learnt from the history of fisheries research—one that cannot be too heavily stressed—it is that the opportunity of dealing effectively with a fishery problem will generally be lost unless this basic knowledge has been obtained in advance and is ready for application. Even in our home waters, which have been examined so long and so closely, our information is not within sight of being complete: in almost every branch of fisheries work there are new fields to be explored, new methods to be tried and many large gaps in the knowledge we possess. But it may at least be said that we have made a beginning. In many other parts of the world not even a beginning has yet been made; ignorance is profound and there is no background of knowledge which can be utilized.

It is surely time that the importance of such knowledge was recognized and that early steps were taken to lay the foundations of fishery science throughout the Empire.

International Standard of Musical Pitch

By Dr. G. W. C. Kaye, O.B.E.

THE problem of the international standardization of musical pitch has recently assumed a new prominence in view of the increasing exchange of concert and similar programmes by the various broadcasting organizations in different countries. The general question has come up from time to time in the past, though it cannot be said that any substantial measure of unification has ever resulted internationally.

The history of musical pitch is one of many 'standards', mainly evolved by some body of standing, which at the time was able to impose its will to a greater or less extent on current practice. In some countries, indeed, the choice of pitch was, and still is, enforced by legal decree. It has long been customary to express musical pitch in terms of the frequency of the note A in the treble clef; and this convention will be observed in what follows.

Ellis (*J. Roy. Soc. Arts*, 1880) gives us a good notion of the state of affairs which prevailed in the early history of musical pitch. It appears that from the fourteenth to the seventeenth century, the note A wandered haphazardly over a range of nearly 200 cycles per second (374 to 567). In the eighteenth century, the upper limit came down by more than 100, the spread of pitch being from 377 to about 423. During the nineteenth century the range was from about 424 to 494, a progressive rise being evident up to about 1887, reflecting no doubt, as always, a striving for increased brilliancy.

In Great Britain, the London Philharmonic Orchestra was the premier orchestra for many years, and the philharmonic pitch was followed by most other orchestras, being first based in 1826 on a value of 433 for A, and afterwards (nineteen years later) on 455. A conference of physicists at Stuttgart in 1834 adopted 440, while a similar conference of musicians and physicists appointed by the French Government in 1859, established the 'Diapason Normal', which was based on a figure of 435 (largely through the influence of Koenig), the associated temperature of the instruments being taken as 15° C. (59° F.). This pitch, which was legalized in France and had a fairly wide vogue in Europe, was adopted by the Boston Symphony Orchestra at its foundation in 1883, and was endorsed in 1885 by an international congress at Vienna. In 1896, the Philharmonic Society adopted 439 at 68° F. (see Hipkins, NATURE, Aug. 31, 1899), while in 1899 an international discussion by the pianoforte trade, which revealed values of A ranging from 435 to 442, also resulted in the adoption of 439 at 20° C. (68° F.) by the participating makers, a decision which materially assisted in checking the general tendency of pitch to rise. Another significant step was the lowering in 1927 by the Army Council of the pitch of British Army bands from 455 to 439 at 68° F.

In the United States, while musical pitch was the subject of many vagaries during the last century, a figure of 440 is now universal, having been adopted by the American Federation of Musicians in 1918, the Music Industries Chamber of Commerce in 1925, and the American Standards Association in 1936. It may be added that this value is in good accord with the usual British figure, as the temperature in American concert halls is said to be customarily of the order of 70° F.

To come to more recent events, a conference was recently held at Broadcasting House under the auspices of the British Standards Institution, with Dr. G. W. C. Kaye in the chair. The conference was attended by representatives of some thirty musical and other organizations, including the Royal Academy of Music, the Royal College of Music, the Royal College of Organists, the Royal Military School of Music, the Musical Association,

the British Broadcasting Corporation, the Old Vic and Sadler's Wells, the National Physical Laboratory and the federations and associations of manufacturers of wind and string instruments and organ and piano builders. The meeting had also before it the views of eminent conductors and professors of music. After a full discussion, the conference agreed unanimously that the British Standards Institution, as a member of the International Standards Association, should be asked to take action to try to secure an international standard of musical pitch. A small committee, which was appointed to draw up definite proposals, has now commenced its labours.

It emerged from the above meeting that, pending international agreement, the British Broadcasting Corporation has provisionally adopted a figure of 439 for the treble A. It also appeared from radio observations made in Germany that many of the musical performances now broadcast from different countries in Europe are based on a pitch exceeding 435, being on the average about 443.

The most recent information available appears to indicate that the accepted figures for A in most countries lie between 435 and 440 cycles per second, although this range is definitely broadened in actual practice. On the whole, it would seem that if an international figure were to be adopted, it will probably be at or near 440. The choice of such a figure, which is of course absolute, would be the primary duty of an International Conference.

The next duty, though a secondary one, would be to deal specifically with the temperature question. Many musical instruments, as at present constructed, exhibit appreciable temperature variation of pitch. The majority of the stringed instruments present, of course, no difficulty in this respect, and, as regards the piano, its pitch is stated to fall by only about 1 part in 18,000 for 1° F. rise in temperature: actually, the effects of humidity changes are probably more significant. In the case of the wind organ, which presents the major problem, the pitch of the flue-pipes rises about 1 part in 500 for 1° C. rise (that is, about 1 in 1,000 per 1° F.) for moderate temperature variations. In other words, a pitch of 435 at 15° C. becomes 439 at 20° C. The orchestral wind and reed instruments (flute, oboe, clarinet, etc.) are also influenced by the warmth of the breath, fingering, etc.; they are said to have, on the average, about half the temperature coefficient of the wind organ.

One of the great difficulties with most concert halls is the steady rise of temperature as a concert progresses, so that the pitch of an orchestra may rise by five or more cycles a second during the early stages of a concert. It has been observed in Germany that, after the entry of wind instruments which had been kept cold, a sudden shifting of the pitch of an entire orchestra may often result. Thus the concert pitch may be subjected to continual fluctuations during the playing. Improvement may be effected by warming the instruments before a concert to bring them into a steady condition.

The oboe, which is often used as an orchestral standard of pitch, is demonstrably unsatisfactory for the purpose. The piano is clearly better, and a steel tuning fork better still, with a drop in pitch of only about 1 part in 16,000 for 1° F. rise in temperature. Elinvar forks are even better, with a positive or negative coefficient varying in different samples up to 40 parts in a million. Valve oscillators with mica condensers can be readily constructed which have a temperature coefficient of pitch of less than 1 part in 1,000.

There are two features which are likely to simplify the temperature question in the future. One is the increasing vogue of air-conditioning, which will make the temperature control of concert halls more feasible. The other is the rapid development of electro-acoustical instruments, such as the electric organ, which have no temperature coefficient, and would appear to present an important field of development. Incidentally, the values adopted for the treble A in two well-known makes of electric organ are 439 and 440 respectively.

It is, of course, appreciated that temperature variation may be especially troublesome under outdoor conditions, which may be extreme in some countries, and it is probably impossible to legislate for such untoward circumstances. Something can be done, it is stated, by pre-tuning the different instruments, for example, in the case of military bands in tropical countries, by flat-pitch tuning of the wind instruments and sharp-pitch tuning of the percussion instruments.

It is clear, however, that as things are at present, international agreement can only be secured for what may be termed reasonable concert-hall conditions, and until those conditions are such that the pitches of musical instruments are virtually free from temperature change, the working temperature will normally require to be specified. It seems probable from the above that a figure at or near 20° C. (68° F.) is likely to be acceptable to the majority of nations.

The indications are that an international conference on the question of musical pitch may be convened in 1939. It would accordingly be appreciated if those readers of NATURE who are interested in the general situation would be good enough to communicate with the Director, British Standards Institution, 28 Victoria Street, London, S.W.1.

Science and Engineering in Antiquity

GIBBON, in "The Decline and Fall of the Roman Empire", when describing Rome in all its glory, said the city was "filled with amphitheatres, theatres, temples, porticoes, triumphal arches, baths and aqueducts, all variously conducive to the health, the devotion, and the pleasures of the meanest citizen". The aqueducts appealed especially to him, and of them he wrote, "The boldness of the enterprise, the solidity of the execution, and the uses to which they were subservient, rank the aqueducts among the noblest monuments of Roman genius and power." They evidently make the same appeal to Mr. W. J. E. Binnie, who, having taken as the theme for his presidential address to the Institution of Civil Engineers, delivered on November 1, "Science and Engineering in Ancient Times", devoted many of his remarks to the work of Frontinus on the aqueducts. This subject no doubt was also a congenial one, owing to Mr. Binnie's own work as a hydraulic engineer.

Sextus Julius Frontinus, who was born about A.D. 35 and died about 106, was a very able and conscientious government servant, and for a time was governor of Great Britain. When about sixty years of age, he was appointed "Curator Aquarum" or Commissioner to the Water Supply of Rome, and this led him to write his two books, "De Aquis Urbis Romæ", an English translation of which was published in 1899, by the distinguished American hydraulic engineer, Clemens Herschel (1842–1930), himself the inventor of the Venturi meter. When Frontinus took office, there were nine aqueducts carrying water to Rome, and one of them had been in use nearly four hundred years, a longer period than Drake's leat has carried water to Plymouth. The total length of the nine aqueducts was 263 miles, about 35½ miles being borne on arches. The total capacity as estimated by Herschel was 84 million gallons a day, but the actual quantity supplied did not amount to more than 38 million gallons. The Appian aqueduct (313 B.C.) was sixteen miles long and was almost entirely underground; the Anio Vetus (273 B.C.) was forty miles long. The Marcia was fifty-eight miles long, and was constructed about 145 B.C. The two older aqueducts followed the contour of the ground, but in the Marcia, arches with a total length of six and a half miles carried the aqueduct across the valleys. The Claudia, the Julia, fourteen miles, the Virgo, thirteen and a half miles, the Alsietina, twenty-nine miles, and the New Anio were erected nearer the age of Frontinus, some of them indeed in his lifetime. One portion of the Claudia was a tunnel three miles long.

The three earliest aqueducts were constructed of dressed stones about 18 in. × 18 in. × 42 in. set in mortar, but most of the later aqueducts were of concrete and brickwork; the arches being divided into voussoirs by brick courses. The waterways were rendered with *opus signinum* made of pottery ground into powder mixed with lime mortar. The durability of this lining is shown by old underground tanks and conduits in Alexandria, where the surrounding limestone has been eroded away by water, leaving the lining intact. Settling tanks were provided on each aqueduct, and water was led into buildings by lead pipes. Payment was made according to the diameter of the bronze nozzle or *calix* through which the water flowed.

Frontinus was aware that the quantity of water varied with the head, and the length of pipe, but the laws governing the flow of water were unknown. By-laws existed regarding the water supply, and it fell to the lot of Frontinus to enforce them.

In considering the construction of the roads, aqueducts, and tunnels of antiquity, a question naturally arises as to what methods were employed in surveying and laying down the plans. The answer to this question was given by Mr. Binnie earlier in his address, when dealing with the writings of Hero of Alexandria.

To Hero are attributed a book on "Pneumatics", three on "Mechanics", one on "Catoptrics", and another on the "Dioptra". The "Pneumatics" has been published in English, and the other five have been translated by Mr. R. C. S. Walters, a member of the Institution of Civil Engineers, and Mr. Binnie had had the advantage of perusing his manuscripts. In this connexion, it is perhaps worth recalling that in 1921 Mr. Walters read a paper to the Newcomen Society entitled, "Greek and Roman Engineering Instruments", and that in 1928 the University of Washington, Seattle, U.S.A., published Mr. E. N. Stone's pamphlet on "Roman Surveying Instruments". For lengths, the Romans used the *Pertica*, the *Decempeda*, and also the *Hodometer*, or road-measurer; for horizontal angles they used the *Groma*, an example of which was unearthed at Pompeii in 1912, while by means of the *Dioptra* they could measure both horizontal and vertical angles. The *Dioptra* was the forerunner of our theodolite, and with it, said

Mr. Binnie, very accurate levelling could be carried out and it was possible to set out aqueducts with very flat gradients.

Besides the writings of Hero and Frontinus, Mr. Binnie touched upon the work of the Egyptians and their methods of drilling granite; the views of Lucretius on matter, the universe and time; the career of Archimedes; and finally and briefly, the work of that versatile genius Leonardo da Vinci, a review of whose many activities was given by Mr. E. McCurdy to the Royal Institution on March 19, 1920, a full report appearing in NATURE of May 6 and 13; and by Mr. J. W. Lieb in a paper read to the Franklin Institute in 1921.

Obituary Notice

Prof. Karl Sudhoff

WE regret to announce the death of Karl Sudhoff, the Nestor and doyen of medical historians, which took place at Salzwedel in Saxony on October 8 at the ripe age of eighty-four years.

Sudhoff was born on November 26, 1853, the son of a theologian and philosopher, at Frankfort-on-Main, the birthplace of Goethe, who formed the subject of many of his non-medical writings. He qualified at Erlangen in 1875 with a thesis on a subject—primary multiple carcinoma of the osseous system—which gave no indication of his future activities, and for the next thirty years remained in general practice with a leaning towards gynæcology, first at Bergen near Frankfort and afterwards at Hochdahl near Düsseldorf. He soon rose to eminence in his profession, and his financial success enabled him to accumulate a library rich in medico-historical works.

During this time, Sudhoff won a considerable reputation by his studies on Paracelsus, so that he was elected the first president of the German Society of the History of Medicine, founded in 1901. Four years later he was appointed as the first occupant of the chair of the history of medicine at Leipzig, where he founded an institute for this speciality, and held this post until 1924, being succeeded by his brilliant pupil, Dr. Henry E. Sigerist, now professor of the history of medicine at Johns Hopkins University.

Sudhoff's activities may be considered under three headings: (1) his successful career as a medical practitioner, in acknowledgment of which he was created a councillor in 1900; (2) his epoch-making work as a medical historian; (3) his ability as an organizer. Sudhoff was an extraordinarily prolific writer, as is shown by the fact that a bibliography of his works and those of his pupils occupied nearly thirty pages of the *Festschrift* dedicated to him in 1924 on the occasion of his seventieth birthday, and more than fifty pages of his *Archiv* published ten years later. His chief works, in chronological order, were his studies of Paracelsus, the iatro-mathematicians of the fifteenth and sixteenth centuries, the anatomy of the Middle Ages, the history of hygiene, German medical incunabula, Alexandrian medicine, ancient balneology, manuscript plague tracts, the early history of syphilis, the school of Salerno, the surgery of the Middle Ages, the history of dentistry, a survey of the history of medicine, and early writers on paediatrics. His minor works included obituaries of medical historians and others, an autobiographical sketch entitled "Aus meiner Arbeit", and numerous reviews of current literature on the history of medicine. In addition to purely medical subjects, he wrote on folk-lore, magic, alchemy, astrology and Goethe in relation to the Rhineland.

Mention should also be made of his editorial work. In 1908 Sudhoff founded the *Archiv für die Geschichte der Medizin und der Naturwissenschaften*, to which his name became attached in 1929; in 1909 he became editor of *Klassiker der Medizin*, and he was also joint editor of several other medico-historical publications.

The organizing ability of Sudhoff was shown by his establishment of the Institute for the History of Medicine at Leipzig, which he made a model of its kind, the organization of the Goethe exhibition in 1899 on the occasion of the hundred and fiftieth anniversary of the poet's birth, the active part which he took in the preparation of a historical section in the German exhibition of hygiene at Dresden in 1911, and his activity as dean of the medical faculty at Leipzig in 1922–23.

Sudhoff had many friends in Great Britain, to which he paid several visits both before and after the Great War. His *Festschrift* was dedicated to him by Sir Clifford Allbutt, and several other British writers contributed to the volume. He was elected a corresponding member of the Section of the History of Medicine of the Royal Society of Medicine in 1913, the year of the International Congress of Medicine held in London, when he read a paper at the historical section of the Congress on the origin of syphilis, and thirteen years later he was elected an honorary fellow of the Royal Society of Medicine.

J. D. R.

WE regret to announce the following deaths:

Sir John Griffith, president of the Institution of Civil Engineers in 1919, on October 21, aged ninety years.

Mr. George Jennison, formerly owner and principal curator of the Belle Vue Zoological Gardens, Manchester, on October 21, aged sixty-six years.

Colonel J. Clibborn, C.I.E., formerly principal of the Thomason Engineering College, Rorkee, known for his work in connexion with irrigation in Northern India, on October 31, aged ninety years.

News and Views

Geophysical Research at Johannesburg

On October 21, the Bernard Price Institute of Geophysical Research at Johannesburg was opened by General Smuts. It is specially fitting that Johannesburg, perhaps the wealthiest and most industrialized city in Africa, the prosperity of which depends so largely on mining, should be the seat of this important new enterprise. The Institute is governed, in finance and administration, by a Board of Control directly responsible to the Council of the Witwatersrand University. The University has been enabled to establish and staff the Institute by gifts from the Carnegie Corporation of New York, and from Dr. Bernard Price, resident director of the Victoria Falls and Transvaal Power Company. Dr. Price's deep interest in the work and success of the Institute is shown also in his chairmanship of the Board of Control. The Institute is under the direction of Prof. B. F. J. Schonland, who as Carnegie-Price professor of geophysics gives post-graduate teaching in the University. At present, the Institute also has on its staff three scientific assistants.

The Institute building, situated in the University grounds, has about 6,000 sq. ft. enclosed floor space, on two floors; the first story extends only over about half the ground floor, so that there is a large roof terrace over which the first floor building can be extended later if necessary. In addition to the director's office, the library, workshop, store room, dark room and so on, the building contains a seismograph room, an oscillograph room, and five research rooms, in which are incorporated many special features appropriate to the needs of a geophysical research institute. There is also a guest room for the use of overseas visitors who may be co-operating in the Institute's research programme. The present programme of the Institute includes atmospheric electricity (a subject in which Prof. Schonland has already made outstanding contributions to knowledge, and which is of special local importance in view of the severity and prevalence of thunderstorms there), seismology, the study of the magnetic properties of the rocks of the Witwatersrand, and the behaviour of rocks under pressure. Radio studies are also being planned.

Institute of Ornithology at Oxford

The statute relating to the proposed Edward Grey Institute of Field Ornithology was brought before Congregation at Oxford this week. Accommodation and funds for the Institute will be provided by the University. There will be a salaried director. The committee of management, although mainly of University members, will have representatives of the British Ornithologists' Union, the Oxford Ornithological Society and the British Trust for Ornithology. The business of the Institute will be to carry out research on problems of ornithology, especially on the numbers, distribution, movements, habits and economic status of British birds and to publish the results obtained. It is evident that activity will be concentrated on field work and will begin by extending that done by the Oxford Ornithological Society. The Society has recently made a count of all species over small areas like Bagley Wood and of the waterfowl on the lake at Blenheim. It has also made surveys of a single species over a wider area as, for example, the count of all the rookeries in an area of more than nine hundred square miles around Oxford.

International Committee on Intellectual Co-operation

The report by Prof. G. de Reynold on the work of the twentieth plenary session of the International Committee on Intellectual Co-operation of the League of Nations (Geneva: League of Nations. London: George Allen and Unwin, Ltd. C.253.M.150.1938.XII) indicates the services to intellectual life which this organization is rendering both directly and indirectly. Its influence on the teaching of the principles and facts of international co-operation, the revision of school text-books, the investigation of unemployment among university graduates, its studies on the rights of the scientific worker and the inventor and on the contract of publication, the International Studies Conference and the agreement with the International Council of Scientific Unions are briefly indicated by Prof. de Reynold, as well as its relations with the International Labour Office and the International Museums Office. Prof. de Reynold stresses the importance of the National Committees of Intellectual Co-operation and of the efforts of the organization to keep in touch with and respect al forms of culture, and of utilizing the most modern means of disseminating information. Resolutions adopted by the Committee at its meeting on July 16 are included, and among the appendixes are reports of the Advisory Committee on the teaching of the principles and facts of international co-operation, on the teaching of modern languages as a means of promoting mutual understanding between nations; of the Acting Secretary-General of the Rome International Institute for the Unification of Private Law on the work of the Institute in the field of intellectual rights and of the Advisory Committee on Professional Workers.

A further appendix gives extracts from the general report of the director of the International Institute of Intellectual Co-operation to the International Committee and to the Governing Body. In these extracts, reference is made to obstacles to intellectual life, including the questions of student exchange, libraries, archives, etc., the scientific study of international relations as developed by the International Studies Conference, including a note on the Prague Conference on the university teaching of international relations. Other matters dealt with relate to the

use of broadcasting for disseminating information on international problems of the day, whether by documentary talks, round-table broadcasts or international bibliographic information. The use of the same means for disseminating information on the progress of the sciences and on developments in literature and the arts is also discussed, and for planning and sponsoring such programmes the collaboration of leading scientific institutions in different countries should be solicited. The organization of a central international information office is also proposed, which with regard to scientific information would be in contact with scientific institutions and scientific workers in different countries, and at regular intervals would provide the programme committees with communiqués on recent discoveries and memoranda on new developments. A resolution adopted by the Congress of the International Federation of Associations of Inventors and Industrial Artists recommends that the author of a scientific discovery or invention should not be deprived of his rights because he has himself divulged it in a scientific paper submitted to a learned society or published it in a scientific journal. The resolution also urges an international agreement which in all countries would entitle the author of a scientific discovery or invention to claim a royalty from persons or enterprises utilizing the discovery or invention for industrial purposes.

The School as a Cultural Centre

A RECENTLY issued bulletin of the United States Office of Education, "The School Building: Situation and Needs" by the official senior specialist in school building problems, emphasizes the view that the State schools, both primary and secondary, must provide, not only for the education of pupils enrolled in ordinary course as at present but also for cultural needs of other members of the community, notably adolescents who have left school but are not at work and adults needing re-education in new lines of work made necessary by industrial changes and for recreation during leisure time. It is clear, says the report, that technological advances and the resulting decrease in the number of workers required in industry are going to "make it necessary for the public schools to provide either full-time or part-time education and recreational opportunities for a large proportion of boys and girls, between eighteen and twenty-one years of age, who are neither in school nor at work. School buildings must be equipped for this purpose. A similar expansion of the purposes of school buildings was advocated in two addresses to Section L (Educational Sciences) of the British Association meeting in August at Cambridge by Mr. W. G. Newton and Mr. S. E. Unwin, county architect, Cambridge. The former included in his summary of to-day's requirements to be interpreted in the school architect's building forms "importance of the parent and the use of the school as a cultural centre", while the latter declared that "the school of the future will only be starting its work with child education, it will be a meeting place for people of all ages"; ". . . for adult activities, even if only for evening classes and adult lectures, a common room where the People can meet for discussion or friendly conversation, with facilities for light refreshment, will be necessary."

Industrial Arts and Education

THE report of a Committee appointed by the Commissioner of Education to consider the Interpretation of Industrial Arts in American Schools has been published as Bulletin No. 34, 1937, by the United States Department of the Interior (Washington, D.C.: Gov. Printing Office, 15 cents). The report is primarily concerned with the way in which the study of industrial arts can contribute to a programme of education for a society which is fundamentally industrial, and the significance of such study in providing a background for education for citizenship, apart from its value in stimulating the development of creative and artistic abilities, is stressed. The position of industrial arts in the elementary school, the junior high school, the senior high school, in adult education and in higher education is discussed in separate chapters of the report, and particularly in the senior high school, the contribution of industrial arts to vocational training is emphasized as well as its value in safety education. In the broadest sense, safety education in the sense of providing every citizen with an adequate scientific or technical background for the life he or she is called upon to live in this present age is one of our greatest needs, and the report would be worth while if only for the terse but illuminating way in which it indicates opportunities which are at present often missed.

Utilization of British Hardwoods

MR. W. A. ROBERTSON, director of the Forest Products Laboratory at Princes Risborough, discussed the utilization of British hardwoods in a paper read before the Department of Forestry of Section K (Botany) at the recent meeting at Cambridge of the British Association. The author dealt with some of the more economic species such as oak, beech, ash, birch, sycamore, alder and poplar. In discussing the more valuable hardwoods, oak, beech, ash, etc., Mr. Robertson pointed to the fact well known to the scientific forester that the poorness of the British present-day timber is due to faulty sylviculture—a position which will not be rectified in Great Britain until recognition by owners of woods is given to the fact that they require just as careful and scientific attention throughout the life of the crop as agriculture. Clean grown timber of any type can only be produced by good sylviculture, in which is included the essential item of correct thinning at specified periods. The coming of plywood has opened new modes of utilization of large-sized hardwoods, since British timber of these species is every whit as good as the foreign. Yet, as Mr. Robertson says, the problem of the disposal of thinnings and cordwood still remains a difficulty.

Long Ashton Research Station

RECENT developments in fruit products research are described in the Long Ashton Research Station report for 1937. Since 1932 a comprehensive study has been made of the possibilities of utilizing surplus

and low-grade fruits, both syrups and wines being investigated. In 1934, fruit squashes were included in the programme, and with such success that in the following year production employing the Long Ashton methods was extended to the commercial scale. Even greater success has attended the researches on fruit syrups. The growing popularity of milk bars has resulted in a demand for various syrups as constituents of 'milk shakes'. For the last two years the Research Station has worked in close collaboration with a local firm producing these commodities, and syrups are now being sold on the large scale under the National Mark Scheme. A still more recent development has been the use of these syrups for aerated beverages, the high ascorbic acid content of the juices being an important feature in their favour. Wines made from English fruits have attractive characters and are of full alcoholic strength, but they are relatively expensive, and development on the commercial scale is not expected to be so rapid as in the case of the syrups.

Seismological Work at Stuttgart

A VERY valuable addition to seismological data and an interesting addition to earthquake literature appears in the report of the Stuttgart Seismological Station for 1936, edited by Dr. W. Hiller, which has recently been received. The station is equipped with three Galitzin-Wilip seismographs orientated to record N.-S., E.-W., and vertical movement, two Mainka seismographs of mass 450 kgm. to read N.-S. and E.-W. vibrations, two vertical Wiechert instruments of mass 80 kgm. and 1,320 kgm. respectively, and one trifilar gravimeter. The report gives the readings of seismograms obtained with these instruments, including the phase, time of arrival, amplitude in the three components and remarks chiefly concerning the position of the epicentre of the shock which caused the record. At the end of the report are 15 pages of detailed study of earthquakes with epicentres in the neighbourhood of the station, including two sketch maps—one concerning the Bodensee earthquake of March 15, 1936, and one of the earthquake of April 19, 1936.

Public Service Occupations

A BULLETIN entitled "Training for the Public Service Occupations" issued by the Office of Education, Department of the Interior, United States of America (Vocational Education Bulletin, No. 192. 20 cents) reviews the work already carried out in training for public service occupations below the university level. The Bulletin is concerned with the manual aspects of the public services rather than with the administrative side, and it is intended to interpret the provisions of the George-Deen Act as they relate to the promotion of vocational education for such occupations. It also outlines methods which have been used with success in planning and developing training programmes, and indicates ways in which Federal, State and local trade and industrial educational agencies can assist in the organization of vocational training for such occupations. Incidentally, the Bulletin should serve a useful purpose in educating the general public in the work and problems of the public services, as has been done very successfully in Great Britain in certain civic exhibitions.

New Antarctic Land

IN a slender volume illustrated with photographs and maps, "My Last Expedition to the Antarctic, 1936–1937" (Oslo: Johan Grundt Tanum, 1938), Mr. L. Christensen has recounted all too briefly the voyage of the *Thorshavn* to the Wilkes Land and Enderby regions of the Antarctic. A brief voyage resulted in important work largely through the help of flying. In Lars Christensen and Ingrid Christensen Lands (Kemp and MacRobertson Lands) the mountain ranges were photographed and mapped. The most important discovery, however, was that of the 'missing' land between Crown Prince Olav and Princess Ragnhild Land, where from 24° to 40° E. Prince Harald Land was found from the air. A long range of mountains was noted in the interior. Thus practically the entire coast line of Antarctica from the Weddell Sea eastward to the Ross Sea is now known, and it would appear that in many parts mountains arise through the ice-sheet at greater or less distances from the coast. In several parts, rocky coasts or outlying islands suggest landing places for ground work. Mr. Christensen brought back geological specimens from several of his landings, but he says nothing of their nature.

Communication Equipment for Vehicles

To the *A.W.A. Technical Review*, published by the Amalgamated Wireless (Australasia), Ltd., of July, Dr. G. Builder and J. D. Gilchrist have contributed a paper on communication equipment for vehicles. Since about 1924, specific instructions for one or more units has been effected extensively either by radio telegraphy or telephone broadcasting. This only needed the fitting of receivers in the fleet units; the reports back to the organization headquarters being made when necessary by the ordinary telephone service. The advantages of two-way transmission led very soon to the use of telegraphic transmission from the units to headquarters when it was necessary to acknowledge instructions and make reports. This as a rule required trained radio operators both on the units and at headquarters. As development progressed, the use of telephony rapidly became common and duplex working was adopted. The improvement in the equipment has now made such services almost equivalent to the normal wire-line telephone services. In some cases it is possible to dial any one mobile unit from headquarters, causing a bell to ring in the mobile installation. The personnel of the mobile units, therefore, have not to keep continual watch and are not distracted by calls which do not concern them. It is feasible to arrange a dialling number calling either all the units or a group of them simultaneously. These highly developed systems are rare, but they indicate the inevitable trend of development in the near future. The use of crystal control of transmitter and receiver

frequencies has proved of the greatest value in this connexion. One of the earliest applications was to police work, and this has proved of great value in preventing crime and arresting criminals.

Tuberculosis in Tunisia

IN his inaugural thesis (*Thèse de Paris*, No. 365; 1938), Dr. M. H. Thamer states that in Tunisia, which is a country of 2,608,313 inhabitants with a mixed population consisting mainly of Tunisian Mussulmans (2,335,623) with Tunisian Jews (59,485) and Europeans (213,205), the mortality from tuberculosis is much higher among the Mussulmans than in the other two groups. In Tunis alone there are about 4,000 tuberculous Mussulmans, and tuberculosis alone is responsible for more than a third of all the deaths from epidemic diseases. Further proof of the high incidence of tuberculosis among Mussulmans is furnished by army statistics, according to which 0·59 per cent of the Mussulman soldiers are affected as compared with 0·25 per cent of the Europeans. Moreover, all the Tunisian practitioners are agreed that the number of tuberculous subjects is increasing yearly in enormous proportions, and that the immense majority of the cases are highly infectious and run a rapidly fatal course. At the present time, the means for combating tuberculosis in Tunisia are quite inadequate. The only institution for detecting cases is the Mussulman Dispensary at Tunis, while barely 84 beds are available for all the cases of pulmonary tuberculosis in a population of more than two millions, among whom there are more than 6,000 deaths from tuberculosis yearly. There are at present no institutions in Tunisia for the prevention of tuberculosis among Mussulman children. The following measures, according to Dr. Thamer, are urgently required: (1) for children, the creation of open-air schools, holiday colonies and a preventorium; (2) for adults, the establishment of five sanitary districts for Tunis, Susa, Sfax, Ket and Bizerta respectively, in each of which there should be a tuberculosis dispensary and the provision of about fifty hospital beds; (3) there should also be a sanatorium of about a hundred beds in the suburbs of Tunis; (4) afterwards the anti-tuberculosis campaign should be extended to the smaller towns and the rural districts which constitute about three quarters of the total population of the country.

Government Scientific Publications

MOST scientific workers are aware that from time to time research papers of immediate interest to them in their own particular work appear among Government publications. Even to those who make the fullest and most regular use of such publications, the admirably written and printed "Brief Guide to Government Publications" which has recently been issued by H.M. Stationery Office will probably come as a revelation of the extent and importance of the contribution to scientific, industrial and agricultural research which comes from such sources. Whether in agriculture, economics or social questions, education, medicine and public health, transport and communications, science, industry and technology, H.M. Stationery Office not only supplies innumerable publications containing up-to-date information on specialized subjects, but is also to an increasing extent the channel through which the results of both pure and applied research are published. A very lucid but comprehensive description of the chief Government publications in all these fields as well as in others of less direct interest to scientific workers is contained in this useful guide, and not the least of its merits are the brief but clear accounts of how Government publications are sold and of the catalogues, lists and bibliographies of such publications which are available.

Research on Coal Utilization

THE British Coal Utilisation Research Association has decided to establish an experimental station in London. Premises have been secured at West Brompton, and are now being equipped. Dr. D. H. Bangham, lately professor of chemistry and dean of the Faculty of Science, Egyptian University, Cairo, who has made important contributions to the physical chemistry of charcoal, cellulose and other carbonaceous materials, has been appointed the senior member of the scientific staff, and will take charge of a group of programmes connected with the use of coal. Mr. J. S. Hales, who will take charge of the Domestic Appliances Department, has worked at the Fuel Research Station on the measurement of smoke and the operation of coke fires, and has since served on the research staff of a manufacturer of domestic solid fuel burning appliances. Mr. R. T. Hancock, formerly associate editor and contributor to "Kemp's Engineers Handbook", has been appointed head of the Intelligence Department and editor of the Association's monthly bulletin.

An Electrodeposition Exhibit

MANY examples of the varied applications of electrodeposition were shown at a special exhibition held at the Science Museum, London, in 1935. The success of this exhibition prompted the arrangement of a smaller permanent exhibit, which has been generously presented by the Electrodepositors' Technical Society. The main features of the original exhibition have been incorporated in a single case, which is now on view in the Chemistry Collections of the Science Museum. One of the most interesting sections of the exhibit deals with research, and has been arranged by the Research Department, Woolwich. Here may be seen the results of the systematic studies of electrodeposition problems made at Woolwich and elsewhere during the past twenty years.

Crystals, Molecules and Atoms

IN a review which appeared in NATURE of September 10, p. 455, of the second volume, entitled "The Fine Structure of Matter", of Dr. C. H. Douglas Clark's treatise on atomic and molecular structure, reference was made to the omission of modern quantum theory from Part 3, entitled "The Quantum

Theory and Line Spectra". Dr. Douglas Clark has written pointing out that his complete work has been subdivided for convenience in publication, and that an advertisement of the scheme printed as frontispiece shows that the concluding Part of Vol. 3 will deal with modern quantum mechanics. Papers relating thereto have been sorted for inclusion in Vol. 3, and the Part recently published contains the classical treatment only. Thus while, in the opinion of the reviewer, modern quantum mechanics should have received attention already, Dr. Douglas Clark believes that his plan, which follows the historical order of development as far as possible, will prove satisfactory.

Health Organisation of the League of Nations

The April number (7, No. 2) of the *Bulletin of the Health Organisation* is entirely devoted to the teaching of hygiene, based on a report by Prof. Jameson, Prof. Pittaluga and Dr. Stampar on certain European institutes and schools of hygiene. The June number (7, No. 3) contains papers on the assay of morphine and cocaine, the sero-diagnosis of syphilis, nutrition and nutritive requirements, and undulant fever in France. The final article deals with the significance of codeine as a habit-forming drug; this does not appear to occur, and the medical use of codeine is therefore not a social danger.

Guide to Official Statistics

The annual volume entitled "Guide to Current Official Statistics of the United Kingdom" is now published for 1937 (London: H.M. Stationery Office. 1*s*. net). The greater part of the book is a subject index in which every entry is followed by a list of related publications each referred to by its official number. This is followed by a numerical list of publications. The arrangement makes reference easy, and the book shows the wide range of valuable statistical and other matter that is available.

Announcements

The Lord President of the Council has appointed Dr. G. Stafford Whitby, at present director of the Division of Chemistry, National Research Council, Canada, and formerly professor of chemistry at McGill University, Montreal, to be director of the Chemical Research Laboratory, Teddington, in succession to Sir Gilbert Morgan, who retired on September 30. Dr. Whitby is expected to take up his duties early in 1939.

The Council of the Royal Society of Edinburgh, with permission of the Hon. Lord Robertson, have caused to be incised on the house at 14 India Street, Edinburgh, the following inscription:

JAMES CLERK MAXWELL
NATURAL PHILOSOPHER
BORN HERE 13 JUNE 1831

The Hermann Göring foundation "Reichsjägerhof" has sent an expedition to Greenland for six or seven months investigation of animal and plant life as well as to make geographical and meteorological observations.

At a recent session of the Health Section of the League of Nations, an international commission was appointed to promote uniformity of standards for patent medicines. Dr. Charles H. Hampshire, of London, was appointed chairman, and the other members are Profs. H. Baggesgaard of Copenhagen, E. Zunz of Brussels, M. Tiffeneau of Paris, R. Eden of Zurich, L. van Italie of Leyden and Mr. Ernest Fullerton Cook of Philadelphia.

One of the Hunterian professorships of the Royal College of Surgeons of England has been awarded to Dr. Donald W. G. Murray, of Toronto, who will deliver his lecture in London next year. This is the second time that this award has been made to a Canadian, the other occasion being in 1924, when Dr. William E. Gallie, of Toronto, was so honoured. Dr. Murray has been appointed for his work on heparin, which has been done in conjunction with Prof. C. H. Best, professor of physiology in the University of Toronto.

Dr. Wu Lien Teh, for thirty years in the Health and Medical Service of the Chinese Government, including the directorship of the Manchurian Plague Prevention Service and of the National Quarantine Service, recently retired to his home in Penang. He was editor of the *National Medical Journal* now known as the *Chinese Medical Journal* for fifteen years, and was founder and later president of the Chinese Medical Association.

The Central Association for Mental Welfare has decided, with the approval of the Board of Control, to hold courses and establish a diploma for workers engaged in the teaching and training of low-grade mental defectives. The course will be held from January until December 1939, and the first two terms will be spent in approved occupation centres. The third term will be spent in London and will consist of theoretical and specialized practical work. Further information can be had from the honorary secretary of the Association, 24 Buckingham Palace Road, S.W.1.

According to official statistics, more sugar and margarine are consumed in Denmark than in any other country in the world. During the period 1930–34, the annual consumption of sugar in Denmark was 54 kgm. per inhabitant as compared with 49·5 kgm. in England, 46·3 kgm. in the United States, 25·6 kgm. in France and 10·3 kgm. in Poland.

The *Internationale Zeitschrift für Psychoanalyse* and the journal *Imago*, the official organs of the International Psychoanalytic Society, which are both edited by Prof. Freud, have ceased publication. The *International Journal of Individual Psychology* is also suspending publication.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 838.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

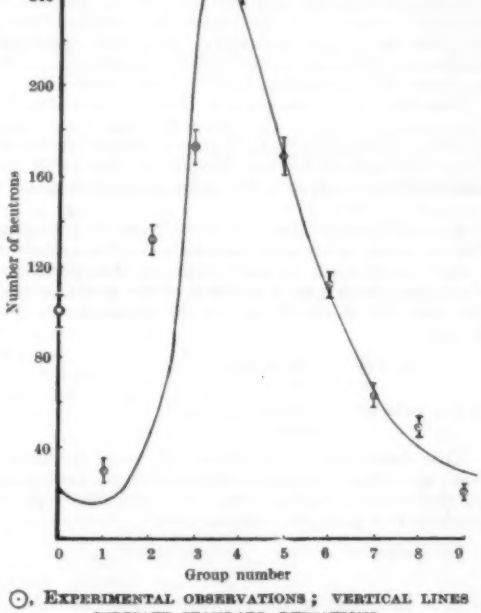
Velocity Distribution of Thermal Neutrons

WE have been developing during the past year an apparatus to make possible the study of neutrons of known energies within the thermal region. In principle, the apparatus consists of a device for producing a burst of neutrons lasting about 0·5 millisecond at intervals of 5 milliseconds. The source is surrounded by paraffin to slow the neutrons down to thermal energies, and these neutrons are then detected by a boron tri-fluoride chamber 5·4 metres away. The electrical pulses from the chamber are amplified and fed to a cathode ray oscillograph. Time signals are also received by the same amplifier and oscillograph whenever the bursts of neutrons occur. Since the neutrons take an appreciable time to cross the 5·4 metres between source and detector, a pulse from the chamber will be recorded later than the time signal corresponding to the burst which produced the neutron, and the distance between the two is inversely proportional to the velocity of the neutron. The traces on the oscillograph screen are photographed on a rapidly moving film, and the distances between the time marks and the pulses measured after development. From an analysis of these measured distances the velocity distribution of the neutrons can be inferred.

The source is a tube of the Oliphant type yielding deuterons, which strike a target of heavy ice. The discharge producing the ions has a voltage of about 20 kv. and is made intermittent by means of a beam of light interrupted by a tuning fork. This light falls on a photo-electric cell the current from which is amplified until it can control the 20 kv. discharge. To accelerate the ions we use a field of between 200 and 250 kv.

The accompanying graph shows the distribution, between ten sub-divisions of the period, of 1,556 neutrons, the faster neutrons appearing to the left. We have calculated the distribution to be expected if Maxwell's distribution law held for the neutrons, taking a temperature of 15° C., and assuming that the efficiency of the boron counter is inversely proportional to the velocity of the neutrons; it is shown on the figure by the curve. A correction, of the order of 20 per cent, has been made to the observed counts to allow for neutrons which did not follow the direct path between source and detector. This was done by making an experiment with a thick boron absorber in the direct path of the beam, and subtracting the result after correcting for the relative strengths of the neutron source under the two conditions.

The curve is adjusted to fit the experimental count for the middle division, and shows reasonably good agreement for the slower neutrons. At the zero of the time-scale appears a group of fast neutrons which have not been slowed down by the paraffin to thermal energies. The discrepancy at divisions 2 and 3 may be due either to a peculiarity in the absorption of boron affecting the efficiency of the chamber at these velocities, or to the hydrogen in the paraffin not being free. This may delay the achievement of equipartition of energy, and affect some velocities more than others. We hope to examine the first suggestion by measuring the absorption of the neutrons of different energies by a boron screen.



⊙, EXPERIMENTAL OBSERVATIONS; VERTICAL LINES INDICATE STANDARD DEVIATIONS.

It will be seen that our apparatus constitutes a 'velocity spectrometer' for slow neutrons. A suggestion for constructing such an apparatus has been put forward recently by Milatz and Horst[1], and Alvarez[2] has described an apparatus which bears the same relation to ours that a monochromator does to a spectrometer, but we believe that the results reported here are the first to be recorded by the method.

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Imperial College, P. B. MOON.
London, S.W.7. G. P. THOMSON.
Oct. 10. C. E. WYNN-WILLIAMS.

[1] Milatz and Horst, *Physica*, **5**, 796 (Aug. 1938).
[2] Alvarez, *Bull. Amer. Phys. Soc.*, **13**, 6 (1938).

Decomposition of Organic Peroxides

Continuing the investigation on the alkyl peroxides[1] and their relation to combustion phenomena, we have now obtained data on ethyl hydrogen peroxide, and propyl hydrogen peroxide.

Ethyl hydrogen peroxide decomposes heterogeneously in the temperature range 140–200°, the rate of reaction being in accord with the expression for adsorption derived from the Langmuir isotherm, due allowance being made for the buffering effect of unchanged peroxide and decomposition products. In agreement with this result, packing the vessel greatly increases reaction rate. It was also found that coating the surface with salt increases the reaction rate, which may be connected with the suppressing effect of salted walls on the reactions of hydrocarbon and oxygen. The products of the peroxide are mostly liquid at room temperature and include acetaldehyde and formaldehyde.

At higher pressures the decomposition is homogeneous, explosive, and is attended with light emission. The products of the decomposition are chiefly gaseous, and resemble those obtained from explosion of the mixture $C_2H_6 + O_2$.

Propyl hydrogen peroxide was not obtained pure, but the preparation used (60 per cent by iodometric method) formed propionaldehyde on heating at 200°, together with a gas containing propylene, ethylene, methane, hydrogen and carbon monoxide. No explosive decomposition has yet been observed.

Both the above compounds initiate markedly the slow reaction $C_2H_6 + O_2$; although they were found to reduce the induction period, they did not, however, affect the subsequent reaction rate; that is, in the expression $\omega = A(e^{\phi t} - 1)$, only A, and not ϕ is changed.

Their initiating effect can be nullified by poisoning (for example, with salt) the surface of the reaction vessel, which leads to the conclusion that the initiation takes place *after* a collision of the peroxide with the wall, which can direct the decomposition in two senses:

(i) peroxide $\xrightarrow[\text{clean wall}]{}$ initiators,

or (ii) peroxide $\xrightarrow[\text{poisoned wall}]{}$ inert products.

This conclusion is in agreement with deductions from the observed accelerating effect of inert gases on the reaction $C_2H_6 + O_2$, for if the first reaction product is a peroxide, the reaction:

(iii) peroxide + fuel $\xrightarrow[\text{(in gas)}]{}$ chain carrier,

will be favoured at the expense of reaction (ii). A possible alternative explanation of the effect of the inert gas would be that it is more adsorbed on the poisoned surface than on the clean surface.

To settle this point, further experiments on the effect of inert gases on the decomposition of these peroxides are in hand.

It is noteworthy that hydrogen does not accelerate the slow oxidation of propane.

E. J. Harris.
A. C. Egerton.

Department of Chemical Technology,
Imperial College,
London, S.W.7.
Sept. 29.

[1] Nature, 141, 472 (1938).

Mechanism of the Rearrangement of Phenyl Ethers

When certain phenyl ethers are heated at their boiling points, the non-aromatic group migrates from the oxygen to the nucleus. The more important groups which so migrate are allyl, benzyl and *tert.*-alkyl. If the rearrangement of some of these ethers is effected in a suitable solvent, the migrating group is transferred, in part, to the solvent. Thus by heating a quinoline solution of benzylphenyl ether, benzyl quinoline is formed together with the normal products of the rearrangement. Toluene is also formed.

These observations find a satisfactory explanation if the assumption be made that the preliminary phase of the rearrangement is the elimination of the migrating group as a free radical. Thus toluene results from the disproportionation of the benzyl radical—a reaction known to occur with free radicals[1]. The transference of the migrating group to the solvent arises out of its reaction with the free radical. The assumption that free radicals take part in the reaction makes clear the observation, hitherto inexplicable, that the rearrangement of benzylphenyl ether is very materially assisted by the presence of metals such as zinc or copper[2].

W. J. Hickinbottom.

Department of Chemistry,
University of Birmingham.

[1] Hey and Waters, *Chem. Rev.*, **21**, 169 (1937).
[2] Belhagel and Freiensehner, *Ber.*, **67**, 1368 (1934).

Splitting of the Hæmocyanin Molecule by Ultra-violet Light

Investigations along different lines (ultracentrifugal sedimentation[1], X-ray analysis[2]) have shown that the proteins contain particles possessing the hall-mark of individuality and therefore are, in reality, giant molecules. We have good reason to believe that the particles in protein solutions and protein crystals are built up according to a plan which makes every atom in it indispensable for the completion of the structure. Primary protein reactions are therefore elementary acts which must, of necessity, obey the laws of quantum mechanics[3].

From this point of view, it would seem of interest to test the action of various energy quanta on proteins under such conditions that complications by secondary reactions are reduced to a minimum. The experience with protein dissociation reactions accumulated in this laboratory[1] indicates that the forces holding the large blocks of very big molecules together are less strong than the forces acting between the dissociable parts of smaller protein molecules. The chance of observing the primary process caused by the absorption of an energy quantum, therefore, appears to be most favourable in the case of proteins of very high molecular weight.

We accordingly chose the hæmocyanin of *Helix pomatia* (molecular weight 6,740,000) as protein material for our first experiments. Splitting of this molecule by ultra-sonic waves has recently been observed in this laboratory[4]. As energy quanta, we used ultra-violet light. Hæmocyanin solutions of various *p*H were exposed to the radiation of a quartz mercury lamp. By means of ultracentrifugal sedimentation determinations, it was found that at a *p*H of 6·2 a splitting into half-molecules occurs. Prolonged irradiation causes denaturation, finally resulting in complete precipitation. It is of interest

to note that at *p*H 6·2 a further splitting of the half-molecules does not take place. At *p*H 7·4, however, both halves and molecules of smaller size are formed. By means of suitable filters, it was found that the photochemical action is confined to the region of wave-length in which the 'protein part' of the molecule absorbs (2·800 A. and shorter wave-lengths). The band corresponding to the absorption of the prosthetic group (3·700–3·200 A.) is inactive.

From these observations we conclude that the weakest bond in the molecule of *Helix* haemocyanin is that holding the two halves together. To split up further by ultra-violet light the half-molecules, an increase in the number of ionized groups is necessary.

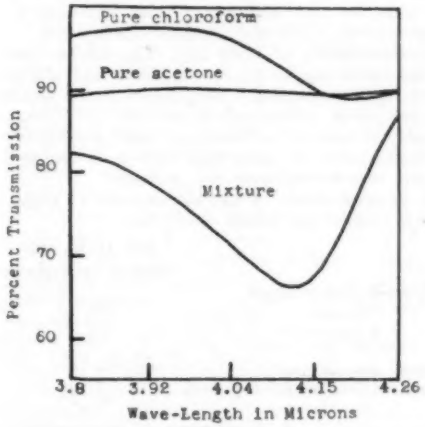
We hope to gain further information by extending these experiments to other high-molecular proteins and by using other kinds of energy quanta.

THE SVEDBERG.
Institute of Physical Chemistry, SVEN BROHULT.
University, Uppsala.
Sept. 30.

[1] Svedberg, T., NATURE, **139**, 1051 (1937).
[2] Bernal, J. D., and co-workers, NATURE, **141**, 521 (1938). Astbury, W. T., *Trans. Faraday Soc.*, **34**, 378 (1938).
[3] Cf. Jordan, P., *Phys. Z.*, **39**, 345 (1938).
[4] Brohult, S., NATURE, **140**, 805 (1937).

Association of Unlike Molecules through Hydrogen Bonds

IN donor solvents, such as acetone and dioxan, the position of the OH fundamental of water, alcohols, or phenol depends upon the solvent so as to indicate hydrogen bond formation between the solute and the solvent[1]. Using CH_3OD, I have extended the work on alcohol mixtures to include new solvents, many of which absorb in the 3 μ region and hence cannot be studied with ordinary alcohol. Most of the amines apparently form very strong hydrogen bonds with an OH or an OD group—that is, in general they produce longer shifts in the OD band than do oxygenated solvents like ethers and esters.



ASSOCIATION BAND IN CHLOROFORM-ACETONE MIXTURE (MOLE FRACTION 0·5; CELL THICKNESS 0·015 CM.).

An interesting case of association between unlike molecules is that of chloroform with other liquids[2]. I have observed an associational band in the region of 4 μ for mixtures of chloroform with donor solvents such as pyridine, ether and acetone. Considering, with other factors, the position of the band and the manner of its variation in position and intensity for the different mixtures, I believe it to be an NH or an OH vibrational band resulting from a hydrogen bond formed by the sharing of the proton of the CH chloroform group with the N or O of the solvent. One of the bands is shown in the accompanying diagram. A similar, but weaker, associational band was found for some bromoform solutions. In all previous infra-red studies of hydrogen bonding, only shifts in the bands of either the solute or solvent were observed—no new bands were found. This seems to be the first direct observation of the new band which would be found in any case of hydrogen bonding, and hence I consider it the most definite evidence yet given for the existence of hydrogen bonds.

A more complete report of these results will appear elsewhere.

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Mendenhall Laboratory of Physics,
Ohio State University,
Columbus, Ohio.
Sept. 14.

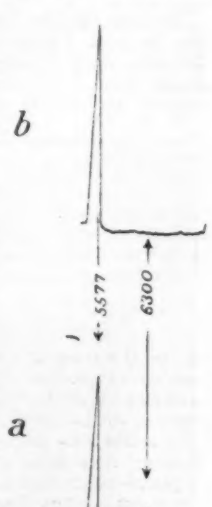
[1] Gordy, W., *J. Chem. Phys.*, **4**, 749 (1936); *J. Amer. Chem. Soc.*, **60**, 605 (1938); Gordy, W., and Nielsen, A. H., *J. Chem. Phys.*, **6**, 12 (1938).
[2] Macleod and Wilson, *Trans. Faraday Soc.*, **31**, 596 (1935); Glasstone, S., *Trans. Faraday Soc.*, **23**, 200 (1936); Gordy, W., *J. Amer. Chem. Soc.*, **60**, 605 (1938); Zellhoefer, G. F., Copley, M. T., and Marvel, C. S., *J. Amer. Chem. Soc.*, **60**, 1337 (1938).

Very Small Intensity of the Red OI Triplet during the Auroral Displays of September 14–16

IT has been shown in previous papers[1,2] that the red aurora of type *A* owes its redness to the enhancement of the red OI-triplet ($^1D_2 - {}^3P_{0,1,2}$) and that the relative intensity of this triplet and the frequency of the red auroras of type *A* seem to follow the sunspot frequency[2,3]. This rule was found to hold for spectrograms obtained since 1923 and up to the winter season 1937–38.

As we approached the present sunspot maximum, the red auroras of this *A*-type and the intensity of the red triplet became very pronounced indeed. On spectrograms obtained during the winters 1936–37 and 1937–38, the red line 6300 was usually about equally as strong as, and sometimes much stronger than, the green line[3,4,5].

Very brilliant auroral displays appeared at Oslo during the two nights September 14–15 and 15–16 this autumn. On both nights we took several auroral spectrograms on panchromatic plates (Agfa Isopan). *Although the green line 5577 appeared with great density on the plates, the red line 6300 was only just visible on one of the spectrograms.* The result is illustrated in the accompanying



a. Sept. 14–15, 1938; exp. 2320–0025
b. Sept. 15–16, 1938; exp. 2045–2400

figure, which gives photometer curves for two of the spectrograms. Only one of these curves shows the red line.

Thus the average intensity of the red line 6300 relative to that of the green one was very small indeed throughout these auroral displays. Not only the red OI-triplet, but also the red bands of the first positive group of nitrogen were relatively very weak.

As a result of the weakness of the red part of the spectrum, the auroras appeared green or bluish. The small intensity of the red triplet is very interesting when seen in connexion with the fact that we are just at a sunspot maximum, and it will be of great interest to see whether this small intensity of the red triplet is maintained throughout this winter and during the next few years. If that is the case, it would mean that the intensity of the red triplet suddenly drops when the sunspot frequency has reached its maximum, and that consequently the agency which is effective in producing the enhancement of the red OI-triplet is not directly connected with the sunspots, but with some other solar phenomenon such as flocculæ or prominences or with some kind of active matter carried to high solar levels as the result of solar activity.

L. Vegard.

Physical Institute,
Oslo.
Sept. 23.

[1] Vegard, L., NATURE, 117, 356 (1926).
[2] Vegard, L., *Geofys. Publ.*, 9, No. 11 (1932).
[3] Vegard, L., *Z. Phys.*, 106, 108 (1937).
[4] Vegard, L., NATURE, 141, 200 (1938).
[5] Vegard, L., *Geofys. Publ.*, 12, No. 5 (1938).

Scattered Reflections of Radio Waves from a Height of more than 1,000 km.

Besides the two main divisions of the ionosphere, the *E*- and *F*-layers, at heights of 120 km. and 250 km., more or less irregularly occurring reflecting layers have been observed. Magnetic storms and auroras are usually accompanied by an increase of

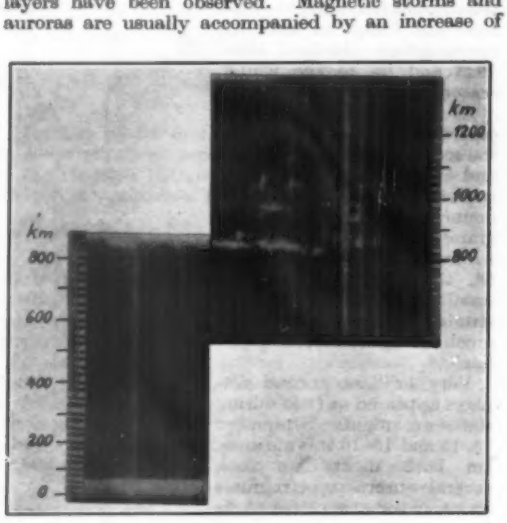


Fig. 1.

Scattered reflections, 850–1200 km. equivalent height. Recorded July 7, 1938, 18h. 0m.–18h. 5m., M.E.T. on 7·65 Mc./sec.

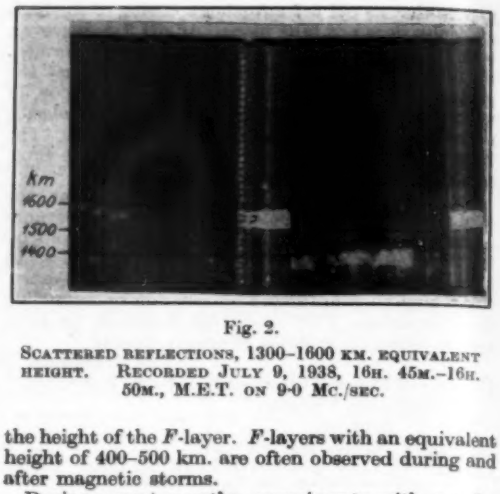


Fig. 2.

Scattered reflections, 1300–1600 km. equivalent height. Recorded July 9, 1938, 16h. 45m.–16h. 50m., M.E.T. on 9·0 Mc./sec.

the height of the *F*-layer. *F*-layers with an equivalent height of 400–500 km. are often observed during and after magnetic storms.

During recent months, experiments with a pulse transmitter with considerable output have been made using frequencies which were higher than the critical penetrating frequencies of the *F*-layer, the latter being controlled and recorded by a second set consisting of a receiver and a transmitter of moderate output. The output of the larger transmitter was more than 50 kw. in the pulse, the aerial used was a horizontal half-wave dipole, the distance between the transmitter and the receiver was 150 m.

On a number of afternoons and evenings, scattered reflections from a region lying between 850 km. and 1,600 km. equivalent height were recorded. Fig. 1 is a record showing scattered reflections between 850 km. and 1,200 km. equivalent height, and Fig. 2 shows scattered reflections with 1,300 km. to 1,600 km. equivalent heights. On the latter figure, the white line indicates a ground-wave 180° out of phase with the pulse emitted. Since a 50-cycle circuit was used for the oscillograph, this indicates a time difference of 1/100 sec., which corresponds to an equivalent height of 1,500 km. The echoes observed on the oscillograph screen are faint and the amplitudes rapidly varying. They seem to be similar to the scattered reflections from the 100 km. level recently described by Eckersley[1] and Appleton[2], and an explanation of these high echoes as due to ionospheric clouds seems to be probable.

A detailed study of the appearance of these high echoes will be published elsewhere.

Leiv Harang.
Willi Stoffregen.

Auroral Observatory,
Tromsø.
Sept. 12.

[1] NATURE, 140, 846 (1937).
[2] *Proc. Roy. Soc.*, 164, 467–476 (1938).

The Electron Neutron Interaction

Recently, we described the results of experiments which led us to the conclusion that electrons are emitted from atoms when they interact with fast neutrons by some hitherto unknown process[1]. On the other hand, Kallmann and Kuhn[2] have shown

that gamma-rays are emitted in the D–D reaction and that the neutron electron interaction postulated by us is not necessary to account for their results.

Recently, we repeated our experiments using the coincidence method of two counters instead of a single counter method. We constructed a pair of thin-walled, semi-cylindrical counters placed close side by side, and only simultaneous discharges taking place in both counters were recorded. In this way we could get rid of many ambiguities with which one inevitably meets in experiments with a single counter. For example, the effect of recoil atoms is completely avoided, and the complete protection of the counters from the X-rays excited in the discharge tubes becomes unnecessary, because the double counter system is insensitive to low-energy electrons. The latter circumstance was a decisive advantage in that it reduced the effect of the secondary gamma-rays excited in matter in the direct neighbourhood of the counter.

With this arrangement we confirmed in the first place that, when carbon was used as the secondary electron emitter, the radiations coming from the target and sensitive to the double counter system consisted chiefly of gamma-rays, in agreement with the result of Kallmann and Kuhn. But, in the second place, when lead was used as the electron emitter, a definite indication was observed that the electrons are emitted by the direct action of fast neutrons. As we have already stated, the postulation of the new effect is only necessary when the effect is observed in the case of light elements (see also Seaborg and Grahame[3]). Our present results can be accounted for by the existence of gamma-rays from the target together with the internal conversion of the lead nucleus excited by the neutrons. The disagreement with our former result seems to have come from the error involved in the estimation of the effect of the secondary gamma-rays excited in the walls of the counter and that of the recoil atoms in the counter. We should like to express our regret for this error.

As to the origin of the gamma-rays coming from the target, their intensity is of the same order of magnitude as would be expected from gamma-rays excited in the substance constituting the target (glass) and the Dewar vessel for liquid air cooling the target. It is, however, probable that they are inherent in the D–D reaction. But their intensity is too low to relate them directly with the low-energy neutron group found by Bonner[4]. The quantum energy of the gamma-rays was estimated by the method of Bothe and Becker and it was found to be about 2 Mev. The value is that to be expected from Bonner's result, but it is indistinguishable from the quantum energy of the gamma-rays excited in most of the substance by the D–D neutrons.

Details of this work will be published shortly in the *Proc. Phys.-Math. Soc. Japan*.

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Hiroo Aoki.

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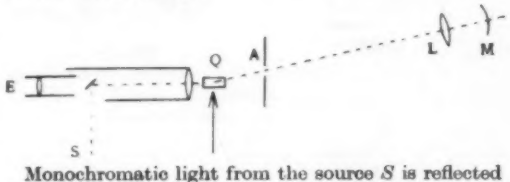
Osaka.
Sept. 15.

[1] See, for example, Nature, **141**, 328, 645 (1938).
[2] *Naturwiss.*, **26**, 106 (1938).
[3] Nature, **141**, 1053 (1938).
[4] *Phys. Rev.*, **53**, 711 (1938).

A New Method of Measuring the Velocity of Light

In determining the velocity of light by Fizeau's toothed wheel, the number of eclipses per second cannot be made more than about half a megacycle. Thus the method requires great distances. In two modern determinations, that of Karolus and Mittelstaedt at Leipzig in 1926, and that of Wilmer C. Anderson at Harvard in 1937, the toothed wheel was replaced by a modulated Kerr cell, and the frequency varied in the one case from 3 to 7 megacycles per second, and in the other case from 7 to 56 megacycles per second. I have recently replaced the Kerr cell by a piezo-electric quartz oscillator working at 115 megacycles per second, and have thus been able to use Fizeau's method with a very short base line.

The accompanying diagram represents the arrangement. Q is the quartz. The periodic electric field is applied in the direction of the arrow, and under its influence stationary ultrasonic waves are formed. At the rarefactions and condensations the density of the quartz is altered; thus its refractive index varies periodically, and if parallel light is incident in the direction of the axis of the telescope, the quartz acts on it like an intermittent diffraction grating. This intermittent grating takes the place of Fizeau's toothed wheel. The first-order spectrum is as bright as the direct image.



Monochromatic light from the source S is reflected down the telescope by a Gauss eyepiece. The aperture A is placed in such a position that only a first-order spectrum gets through. The light then travels along an optical bench AL and is reflected back on its path by the lens mirror combination LM. If, when it returns to Q, the grating is in action, the first-order spectrum is diffracted along the telescope to the eye of the observer at E; if, on the contrary, the quartz atoms are momentarily in their mean positions, there is no diffraction. Thus when the lens mirror combination is drawn back along the bench, the image undergoes a periodic change in intensity. As the grating forms twice in each period of the oscillator and the light has to traverse the path both going and returning, the positions of the mirror which give minima are only about 65 cm. apart. The first position at 32 cm. from the quartz cannot be obtained owing to the aperture A getting in the way, but the others which lie within the range of the bench, at 97 cm., 162 cm., 227 cm., 292 cm. and 357 cm., are all easily visible.

The method is still in process of development, and will later be described in full. It is too soon to estimate its possibilities, but at present it seems better than the other methods for measuring the velocity of light in liquids.

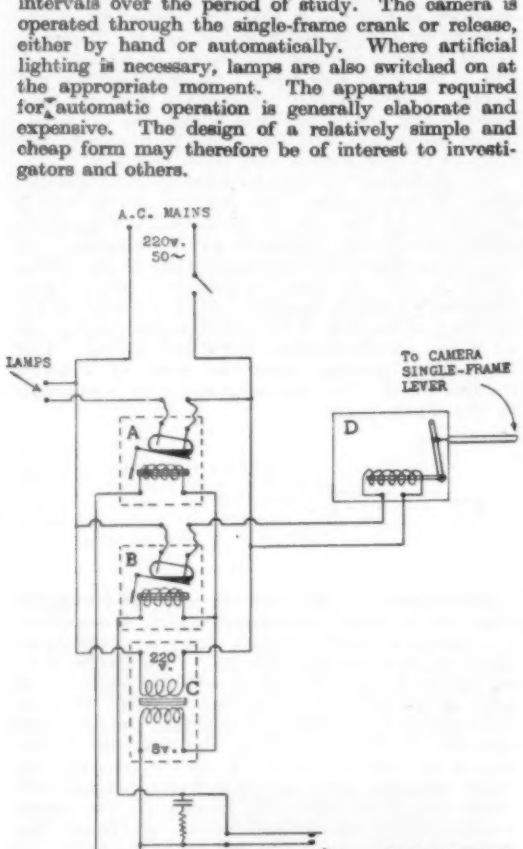
The method was discovered during the course of an investigation supported by the Carnegie Trust for the Universities of Scotland, and I have been indebted to my colleague Dr. John Thomson for freely placing his knowledge of short-wave wireless at my disposal.

R. A. Houstoun.

University,
Glasgow.
Sept. 22.

Automatic Operation of Ciné-camera and Lighting Arrangements for Time Lapse Studies

THE ciné-camera provides a convenient means of recording the growth of plants and fungi, or other very slow movements. The method employed is to expose one or more frames of a film at regular intervals over the period of study. The camera is operated through the single-frame crank or release, either by hand or automatically. Where artificial lighting is necessary, lamps are also switched on at the appropriate moment. The apparatus required for automatic operation is generally elaborate and expensive. The design of a relatively simple and cheap form may therefore be of interest to investigators and others.



A, RELAY OPERATING LAMPS. B, RELAY OPERATING SOLENOID D. C, TRANSFORMER. D, SOLENOID OPERATING CAMERA BY LEVER AND CABLE.

The device described below was developed initially for use in filming the growth of wood-destroying fungus and for demonstrating the efficacy of preservative treatment of wood. Single-frame exposures were required at intervals of 15 minutes over a continuous period of about thirty days. The objects being filmed had to be illuminated only while each frame was taken, as exposure of the fungus to intense light, for other than very short periods, was liable to affect its growth.

Apparatus. The ciné-camera is operated by means of a solenoid (see accompanying diagram), the single-frame release being connected by Bowden cable to a lever, the free end of which is pivoted to the armature. The solenoid and the lamps for illuminating the objects are connected to the mains and controlled by mercury tube relays. A small transformer supplies 8 v. current to the latter. The circuits containing the relays are opened and closed by reed contacts operated by levers and a cam on the minute hand shaft of an eight-day clock.

The method of operating the contacts is a modified form of that sometimes used in electrical master clocks. The cam is four-sided, so that the contacts are closed every fifteen minutes. Each contact is moved by a pair of followers, the inner ones being pivoted to the clock frame and the outer followers being pivoted to the inner at their mid-points. The differences in length of the four cam followers govern the sequence and duration of closing and opening the contacts. The inner followers are in each case shorter than the outer, and when they are dropped by the cam the pivots of the outer followers are lowered, giving angular motion to the latter and so closing the contacts. When the outer followers are dropped in their turn by the cam, they resume their original position relative to the inner followers and open the contacts. The sequence is as follows: The inner follower for the lamp relay contact falls first; a second or so later the inner follower for the solenoid relay contact falls. The outer follower for the latter then falls after a suitable period has elapsed and the solenoid circuit is opened. Soon after, the outer follower for the lamp circuit falls. During the next fifteen minutes the followers are gradually raised by the cam until the operation is repeated.

This arrangement has the advantage that the loading on the clock movement is small and uniform, without tendency to retard or stop the clock when the contacts are operated. The timing is accurate and readily adjustable by slight alteration in the lengths of the followers. Any number of operations from one to thirty or more per hour can be obtained by using suitable cams, larger diameters being required, of course, for the greater frequencies.

When films prepared in this manner are projected at normal rates, the otherwise imperceptible growth or displacement of the object is shown and rhythmic movements may become visible.

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Sept. 22.

Sampling Lake Deposits

WORK by the Freshwater Biological Association during the past year has directed attention to the importance of the deposits at the bottom of lakes as a means of interpreting their history since the Ice Age[1]; and similar work on both freshwater and marine deposits has been progressing in other parts of the world[2]. Cores from the floor of lakes or the sea have usually been taken with a sampler consisting of an open-ended pipe driven vertically into the deposit by its own weight (for example, Bigelow tube), by a hammering device, by exploding a charge at its upper end[3], or by screwing it into the deposits by means of connecting rods operated from a pontoon[4]. Such methods have the disadvantage that the deposits tend to be compressed and distorted by the pipe, so that the resulting core fails to give an accurate picture of the original stratification. The apparatus described in this communication was designed by one of us (B. M. J.) to avoid these

difficulties; it has been tested successfully on Windermere, and should have application to similar problems elsewhere.

Fig. 1 shows the whole apparatus with the sampler proper (*F*) at the bottom, extension tubes (*E*) above it, of sufficient length to penetrate the deepest deposit to be sampled, and above these a length of guide tube on which slides a driving weight (*D*). The gear (*C*) for closing the sampler is carried on a flange at the upper end of the guide tube. A bridle of cable supports the whole apparatus and works the driving weight. The top of the bridle is hooked to a trip release (*B*) on the end of the main cable (*A*).

Fig. 1.

The sampler proper is shown in cross-section in Fig. 2, in the open position (*A*) and closed position (*B*). It consists of an outer tube, of 2½ inch bore, of which one third of the circumference is cut away, and an inner half-tube. The cut side of the outer tube is closed, except for a small longitudinal opening, by a face-plate. The inner half-tube is carried by radial arms on a shaft, which passes upwards to the closing gear, so that, when the shaft is rotated, the inner half-tube projects through the longitudinal opening, passes through an arc of a circle, and closes against the face-plate. The top and bottom ends of the inner half-tube are closed by thin diaphragms, for the passage of which cross slots are left in the face-plate. The bottom end of the outer tube is closed by a solid steel point which slides on its attachment to act as a valve.

In use, the whole apparatus is lowered by a single cable from a pontoon, with the sampler in the open position. Its own weight is sufficient to penetrate the upper soft layers of the deposit, and it can be driven down to the required level by raising and dropping the sliding weight. A messenger-weight sent down the cable then releases the trip, which disconnects the main cable from the driving weight and allows a fine by-pass cable to be tightened by hauling up the main cable. Tension on this fine by-pass cable, transmitted through a pulley and skew-gears (*C*), revolves the central shaft, and with it the inner half-tube, thereby enclosing a core of the bottom deposit in the sampler (Fig. 2, *B*). Loss of any part of the sample is prevented by the diaphragms mentioned above. As the fine by-pass cable completes the closure, a second strong by-pass cable (to the left of *B*, Fig. 1) becomes tight and takes the weight of the whole apparatus as it is hauled out of the deposit. The latter process is made easy by the valve at the bottom of the sampler allowing water to pass down the tube to fill the hole left in the deposit. On reaching the surface, the apparatus is laid horizontally and the closing gear is turned backwards to expose the core, which is then transferred to a trough in which it is stored for examination.

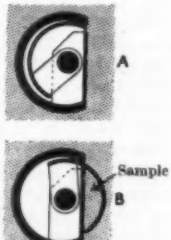

Fig. 2.
A, Sampler open; B, Sampler closed.

The experimental sampler was made to collect cores only 4 feet long, but deeper deposits were explored by using extension tubes (*E*, Fig. 1) to take successive, but overlapping, cores at increasing depths. In this way cores of 9 feet in length were obtained in Windermere. There seems, however, no reason why a longer and better constructed apparatus on the same plan should not be capable of extracting undisturbed cores from considerably greater depths of deposit and under many fathoms of water.

The advantages of this apparatus over others previously used for similar purposes are that: (1) it is worked from a pontoon with only a single cable and is therefore applicable to almost any depth of water; (2) there is no need for connecting rods to the surface; (3) for obtaining cores at successive depths in the deposit there is no need for devices to ensure that the sampler enters the same hole again; (4) there is no compression or appreciable distortion of the core, at any depth, because the inner half tube cuts laterally along the arc of a circle into undisturbed deposit.

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[1] Nature, **142**, 238 (Aug. 6, 1938).
[2] Wasmund, E., "Handb. d. Biol. Arbeitsmethoden", Abt. **9**, 1839 (1936).
[3] Piggot, C. S., *Smithsonian Report for* 1936, 207.
[4] Reissinger, A., *Internat. Rev. d. Hydrobiol.*, **33**, 1 (1936).

Nature of the Gonadotropic Hormone from Pregnant Mare Serum

In a recent communication, Hartman and Benz[1] reported on the carbohydrate content of gonadotropic hormone preparations from pregnancy urine and pituitary gland. A similar result was previously reported by Karl Meyer[2], who investigated a product obtained from Prolan by reaction with iodine. The product obtained contained 11·07 per cent total nitrogen, 16·4 per cent total reducing sugar of which 7·72 per cent was hexosamine. The acetyl value was 3·16 per cent. If these figures are recalculated on the iodine-free substances, the figures are 11·9, 17·7, 8·3, 3·4 per cent respectively.

We have been occupied lately with the purification of products obtained from pregnant mare serum, and we found that they contain considerable amounts of reducing sugar, hexosamine and acetyl groups. They give strongly positive Molisch and Elson-Morgan reactions for hexosamine. The most interesting fact we derived from our investigations is that apparently the relation of total nitrogen and hexosamine nitrogen is in some way characteristic for the purity of the products.

In analysing different products prepared from mare serum which are in the market as well as our own products, we have found that in the average product this quotient, $N_{hex.}/N_{total}$ is between 1/34 and 1/48. The purest product gave 1/14, whereas the above cited preparation from human pregnancy urine[3] showed a relation of 1/18·4. On the other

hand, using the analytical data of Meyer[3], on the glycoprotein, ovomucoid-*a*, a quotient of nearly 1/9 is obtained.

Our findings would confirm the assumption of Karl Meyer and John W. Palmer as to the mucoid nature of gonadotropic fractions.

It may be of interest that the gonadotropic hormones apparently do not contain cystine.

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[1] Nature, **142**, 115 (1938).

[2] Kurzrok, "Endocrines in Obstetrics and Gynecology", p. 115 (Williams and Wilkins, Baltimore, 1937).

[3] Meyer, Karl, *et al.*, Cold Spring Harbor Symposia on Quantitative Biology, **6** (in the Press).

Production of Mammary Carcinomas in Mice of a Susceptible Strain by the Synthetic Œstrogen, Triphenyl Ethylene

It is well known that in certain inbred strains of mice, many of the females develop spontaneous mammary tumours. Few or no tumours occur in the males of these strains or in the females spayed before puberty. When, however, these males are injected with œstrone over prolonged periods, a number develop mammary tumours.

We have produced mammary carcinomas in the males of such a strain by the injection of a synthetic œstrogen. Fifty-three males of the *R* III strain (Dobrovolskaïa-Zavadskaïa) received weekly a subcutaneous injection of 5 mgm. of triphenyl ethylene in oil, the dose being later reduced to 3 mgm. The injections were started before the age of sexual maturity and have been continued up to the present time. Twenty-six mice are still alive after 28 or more weeks of treatment.

So far, ten mammary carcinomas have developed in nine male mice (one mouse developed two tumours). They are of the same histological type as those which occur spontaneously or which are produced by the injection of a natural œstrogen in this strain; that is, they are papillary adenocarcinomas with cystic and degenerative areas. The tumours appeared at 18, 19½, 21 (two mice), 23, 24 (two mice), 26 and 29 weeks of treatment.

Several tumours have also developed in females of the same strain ovariectomized before puberty and afterwards injected with triphenyl ethylene. Their histological examination is at present in progress.

Twenty-nine males and twenty-one females (non-spayed) of a strain which does not spontaneously develop mammary carcinoma (black agouti) have also been injected with triphenyl ethylene for a similar period, and no tumours have so far developed.

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A Hæmoglobin from Bile Pigment

Under this title, Lemberg, Legge and Lockwood have described in Nature of July 23, p. 148, "a new hybrid hæmoglobin" formed by special treatment of hæmoglobin – ascorbic acid solutions. In the summary given, p. 166, one finds the following: "The new compound, like hæmoglobin, combines reversibly with oxygen and carbon monoxide, but the non-protein part of its molecule is a bile pigment closely related to verdohæmatin." This might give the impression that the existence of bile pigment-globin compounds was not known before.

In 1932, Barkan[1] suggested that the 'easily split off' blood iron ("leicht abspaltbares" Bluteisen), discovered in 1925 by him[2], may be a step in the formation of bilirubin. Later Barkan and Schales[3] pointed out that the two fractions *E* and *E′* of the 'easily split off' blood iron accompany the hæmoglobin in the circulating blood as intermediate products of bilirubin formation. *E* and *E′* are hæmoglobin-like compounds in which the bearer is an undenaturated globin, whilst the prosthetic group is a hæmin or hæm derivative with an opened porphyrin ring similar to that in Lemberg's 'verdohæmochromogen'. We called these compounds 'pseudohæmoglobins', and the prosthetic groups 'pseudohæmin' and 'pseudohæm'. We suggested the use of the prefix 'pseudo'. for such products which resemble in many points the 'true' ones and differ from them only by the opening of the porphyrin ring, indicating by the letter α, β, etc., at which methene group the opening took place (in our case α-pseudohæmoglobin, α-pseudohæm, etc.). We were able to show[3] that the two native fractions *E* and *E′* differ by the valence of the iron. It is in the divalent form in *E* (*E* is a pseudohæmoglobin *in sensu strictiori*), but trivalent in *E′* (*E′* is a pseudomethæmoglobin). We were able to transform *E* into *E′* and vice versa[3]. Barkan and co-workers described many properties of the pseudohæmoglobins *E* and *E′*. The most important fact is that the bile pigment – globin compound *E* combines reversibly with oxygen and carbon monoxide according to the 'distribution equation', and that the relative carbon monoxide affinity (by which is meant the ratio of the affinity for carbon monoxide to that for oxygen) is rather greater in the case of *E* compared with hæmoglobin (Barkan and Berger[4]). The pseudomethæmoglobin *E′* (like the methæmoglobin) does not react in this way with oxygen and carbon monoxide.

Recently Lemberg observed that verdohæm (pseudohæm after our definition) unites with native globin to give a hæmochromogen and not a hæmoglobin. Therefore he assumed as a working hypothesis that in the disintegration of hæmoglobin the alteration of the globin part precedes the oxidation of the prosthetic group[5]. Barkan and Schales[6], on the other hand, have emphasized that the existence of *E* and *E′* (that is, of *iron containing bile pigment – globin compounds*) in the normal red blood cells gives evidence that an oxidation of the prosthetic group must be the first step in the breakdown of hæmoglobin. The new statement by Lemberg and his co-workers that an iron containing bile pigment – globin compound is readily formed from hæmoglobin seems, when considered in connexion with our previous work, to support our opinion mentioned above.

There is no evidence, however, indicating whether or not the new hæmoglobin product of Lemberg and co-workers is identical with our pseudohæmoglobin

found in erythrocytes. Thus it is doubtful whether the new name 'choleglobin' is necessary and suitable. The choice of rather unsystematic names in bile pigment nomenclature is, we find, a hindrance rather than a help to discussion.

Some other details in the letter of Lemberg and co-workers may be discussed elsewhere.

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[1] Barkan, G., *Klin. Wschr.*, 1050 (1932).
[2] Barkan, G., *Hoppe-Seylers Z. physiol. Chem.*, **148**, 124 (1925).
[3] Barkan, G., and Schales, O., *Hoppe-Seylers Z. physiol. Chem.*, **248**, 96 (1937).
[4] Barkan, G., and Berger, E., *Klin. Wschr.*, 1868 (1928) and *Arch. exp. Path. u. Pharmakol.*, **138**, 278 (1928).
[5] Lemberg, R., "Perspectives in Biochemistry" 137 (Cambridge: University Press, 1937).
[6] Barkan, G., and Schales, O., *Hoppe-Seylers Z. physiol. Chem.*, **253** 83 (1938).

A Viable Homozygous Deficiency in *Drosophila melanogaster*

THROUGH combination of fragments of chromosomes from two complicated rearrangements (obtained in my work dealing with the w^{mt} position effect, 1938, in the press), one of which causes a light w^{mt} and the other a very dark w^{mt} eye colour, the first having the break to the left and the other to the right of the *w* gene, a stock was obtained which had no *w* gene in its genotype. Since the cytological observations show that the breaks occur near each other, or even at the same point in both the original aberrations, it was concluded that only one gene, namely, the gene white, was deficient. The cytological data agree well with the phenotypical actions of the *w* deficiency, which does not differ from a simple *w* mutation, causing the white eye colour. The cytological observations agree also with the data obtained by numerous authors showing the position of the *w* gene in the $3C_2$ region of Bridges' salivary chromosome map. But in the *w* deficiency combinations the $3C_2$ band is not thinner than in the normal chromosome.

This may serve as evidence for the conception that the genes are really localized in the intrabandular areas. In this case the *w* gene must be included between the disks $3C_1$ and $3C_2$ in the *X*-chromosome map. It may be also that this finding, which does not agree with the data of Shultz (1938), who has shown that in the *w* mutations the $3C_2$ disk is thinner than in the normal chromosome, is caused by the fact that in both of the original aberrations and in their compound, the $3C_1$ and $3C_2$ disks, which are translocated from chromosome IV to chromosome II L, stain more deeply by aceto-carmine, that is, more nucleic acid is present.

The *w* deficiency males and females (the latter have been obtained by crossing *w*-deficient males to notch[8] females) do not differ from the typical w^w mutations, and have no other pleiotropic effects. The increased sterility of the *w*-deficient males is due probably to the original sterility effect present in one of the aberrations involved.

It is the second undoubted case of viable homozygous deficiency; the first was obtained by H. J. Muller (1935, the *y*, *ac* deficiency). The phenotypical effect which is caused by the *w* deficiency corresponds well with Muller's theory (1932) of the action of hypomorphic and amorphic mutations. Thus, the *w* mutations are typical amorphic mutations and probably some of them are caused by real deficiencies. The viability of the deficiencies and the absence of pleiotropic effects in these flies shows a high degree of discontinuity of the hereditary substance in the sense that the role taken by some genes is very low and that they affect few physiological functions of the whole organism. This may be caused by a high degree of duplication of genes, partially not homologous with each other.

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Thermal Conductivity of Mud Brick

INVESTIGATIONS of the thermal conductivity of mud brick, of which the methods of manufacture with mud and straw seem to have remained practically unchanged through thousands of years, have been made with small- and large-scale apparatus.

Results with small samples 10 cm. in diameter and from 1 cm. to 2 cm. thick have given results ranging from $3{\cdot}8 \times 10^{-4}$ calories per sq. cm. per 1° C. temperature gradient per sec. with much straw to $8{\cdot}0 \times 10^{-4}$ C.G.S. units with minimum straw.

The results with mud brick walls built vertically in 150 cm. × 140 cm. × 28 cm. frames vary from $3{\cdot}9 \times 10^{-4}$ to $6{\cdot}0 \times 10^{-4}$ C.G.S. units. The weight of water in the bricks was found to vary by some 15 per cent according to the humidity of the air. Such bricks appear considerably better heat insulators than ordinary burnt bricks now used in constructional work, but are less heat insulating than the best cellular concrete.

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Bluffing by Eclipse Prediction

LIVY's description of the Roman general, C. Sulpitius Gallus, warning his men before the battle of Pydna (168 B.C.), that an eclipse of the moon would take place on the following night is well known. He gave a scientific explanation of the phenomenon so that they should not take it as an adverse omen. The Macedonians, on the other hand, were, according to the historian, unprepared and thoroughly alarmed.

Less familiar is the very effective use of a solar eclipse by the Byzantine Emperor, Alexius I. Comnenus, who figures so prominently in the history of the First Crusade. To quote the words of his biographer, his daughter Anna Comnena:

"In the course of the discussion a certain Nicolas, one of the Emperor's secretaries, came up to him and whispered in his ear, 'You may expect an eclipse of the sun to take place to-day', and on the Emperor's expressing a doubt, he swore with an oath that he was not lying. Then the Emperor, with his habitual quick-wittedness, turned to the Scythians and said, 'I appoint God as Judge; and if a sign appears in the heavens this day, you will know for a surety that I have good reason for suspecting, and therefore not receiving, your embassy because your leaders are not sincere in their overtures for peace. If, however,

no sign appears I shall stand convicted of having been wrong in my surmise.' Before two hours had passed the light of the sun failed and the whole disk was darkened by the moon's passing over it. At that sight the Scythians were terrified." ("The Alexiad," translated by Elizabeth A. S. Dawes. London: Kegan Paul, 1928.)

In fiction, we have Mark Twain and Rider Haggard making use of this device; Rider Haggard's description of the duration of an eclipse being a stock example of a scientific 'howler' in literature. It would be interesting to find who first thought of this form of bluff in imaginative writing. The earliest reference I can discover is in the romance "The Prairie-Bird", by the Honourable (Sir) Charles Augustus Murray. My copy is dated 1854, but, according to the Dictionary of National Biography, this book was published in 1844.

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Points from Foregoing Letters

Experiments have been made by G. E. F. Fertel, Dr. P. B. Moon, Prof. G. P. Thomson and Dr. C. E. Wynne-Williams on the distribution of velocities among the neutrons emitted from a source surrounded by paraffin. By using as the source an intermittent discharge they find that, with one apparent exception, the distribution follows the Maxwell law.

Ethyl hydrogen peroxide decomposes heterogeneously in the temperature range 140–200° according to E. J. Harris and Prof. A. C. Egerton. Coating the surface of the vessel with salt increases the reaction rate and at higher pressure the decomposition is explosive. The authors discuss the action of this and other organic peroxides upon propane-oxygen mixtures.

From a study of the rearrangement of benzylphenyl ether and similar ethers in suitable solvents, Dr. W. J. Hickinbottom suggests that the observed facts are best explained by assuming that the rearrangement is dependent on the intermediate formation of free radicals.

Irradiation of hæmocyanin (mol. weight 6,740,000) with ultra-violet light of wave-length corresponding to the absorption band due to the protein part of the molecule (around 2800 A.), leads to the splitting of the molecule, according to ultracentrifuge experiments by Prof. The Svedberg and S. Brohult. The authors consider that primary protein reactions are elementary acts which obey quantum mechanics.

A graph showing a new absorption band in the region 4μ in mixtures of chloroform with acetone, due to association between the molecules of these solvents, is submitted by Prof. W. Gordy, who states that this is the most definite evidence yet published for the existence of hydrogen bonds between associated molecules.

A very small intensity of the O I triplet in the auroral spectrum during the displays of September 14–16, which resulted in the auroras having a greenish or bluish tinge, is reported by Prof. L. Vegard, who suggests that the enhancement of that radiation in the auroral spectrum prior to the sunspot maximum may be due to some kind of active matter carried to high solar levels as the result of solar activity.

Dr. Leiv Harang and Willi Stoffregen have obtained scattered reflections of radio waves from heights between 850 km. and 1,600 km. equivalent height, using a pulse transmitter with considerable output. The frequencies used were higher than the critical penetrating frequencies of the F_2-layer. The scattered reflections are explained as due to ionospheric clouds.

Dr. R. A. Houstoun describes a variation of Fizeau's method of determining the velocity of light, in which the toothed wheel is replaced by an intermittent diffraction grating. This enables the range to be diminished to a four-hundredth of its value.

An arrangement for recording the growth of plants and other very slow movements by photographing at fixed intervals with a ciné-camera is described by P. Harris. Advantages claimed for the new arrangement are that the clock movement is small and uniform, and the timing accurate and easily adjustable, so that from one to thirty or more operations per hour can be readily obtained.

A device for sampling lake deposits, in which the inner half tube cuts laterally along the arc of a circle so as not to disturb the deposits, is described by B. M. Jenkin and C. H. Mortimer. The apparatus is worked from a pontoon with only one cable, without connecting rods to the surface, and samples at successive depths can be taken without the sampler having to enter the same hole again.

G. Fleischer, Dr. E. Schwenk and K. Meyer find that the proportion of hexosamine in relation to the total nitrogen in the gonadotropic hormone present in pregnancy urine is of the same order as that in the glycoprotein, ovomucoid-α. The authors consider that this supports the view concerning the mucoid nature of gonadotropic extracts.

Dr. J. M. Robson and G. M. Bonser report that injections of triphenyl ethylene (a synthetic œstrogen) lead to the production of tumours in male mice of a strain in which females alone develop spontaneous tumours.

Prof. G. Barkan and O. Schales have pointed out that in the red blood cells there are present iron-containing bile pigment – globin compounds. These 'pseudohæmoglobins' accompany the hæmoglobin in the circulating blood as intermediate products on the way to bilirubin formation. The recent work of Lemberg and his co-workers described in Nature is believed to support the opinion of Barkan and Schales that an oxidation of the prosthetic group and not an alteration of the protein part may be the first step in the breakdown of hæmoglobin to bilirubin.

Through combination of fragments of chromosomes from two complicated rearrangements found in two varieties of the fruit-fly (*Drosophila*), one of which causes a light and the other a dark eye colour, I. B. Panshin has obtained a stock in which the gene white is absent in the genotype. Cytological observations support the view that the genes are localized between the dark-staining bands of the chromosomes.

Research Items

Indians of the Copper River Delta, Alaska

A DETAILED record and analysis of the culture of the Eyak Indians by Dr. Kaj Birket-Smith and Dr. Frederica de Laguna ("The Eyak Indians of the Copper River Delta, Alaska", *Kgl. Danske Videnskabernes Selskab.* København: Levin and Munksgaard, 1938. Pp. 592+18 pl.) is based mainly on observations made during an expedition to Prince William Sound in the summer of 1933. The Eyak, it had been estimated in 1930, were distinct from Eskimo, Tlingit and the Atna, or Athapascan-speaking tribes of the Copper River Valley. The hypothesis then suggested that they were a group of the Athapascans who had come from the interior down the river is here tested and discussed in the light of intensive ethnographic study. Eyak culture is an extremely complicated thing, as might be expected from their geographical situation on the borders of three or four of the principal culture areas of North America, and close to the main cultural gate between the two hemispheres. The basic structure seems fairly clear. More than eighty Eyak elements, namely, 45 per cent of the 183 traits studied, are classed with the ice-hunting culture. They belong to all phases of human life, comprising dwellings, dress, conveyance, house utensils and tools, hunting methods and weapons, magic and religion, etc. The elements of the snow-shoe culture, on the other hand, are exceedingly few in number and of a casual character. This culture can never have been adopted as a whole. The analysis of Eyak culture adds strength to the evidence of a circum-Pacific culture stream, as 27 of its elements seem to belong here. Further, the greater part of the 22 Tlingit elements must be included among circum-Pacific traits, as in most instances they are elaborations of Old World forms, which have drifted back to the north. The origins of the remaining elements can be classified roughly as follows: Asiatic without belonging to any well-defined complexes previously mentioned (9 elements); Eskimo Thule culture and north-west coast, chiefly from the southern area of the latter (7 elements); Eskimo Thule traits (10 elements); North-East Coast and Plateau, or in a few cases only, the latter (17 elements).

Blood-groups in India

IN a paper on the blood-group distribution in India (*J. Genetics*, **36**, No. 2) Dr. Eileen Erlanson Macfarlane discusses previous results and adds new ones from different parts of India. Different castes as well as races have been compared, and, as might be expected, the castes differ in their blood groups. The rather small samples indicate that, in Bengal, *A* is similar in different castes, as would be expected if it is of ancient origin; but the percentage of *B* increases and that of *O* decreases in the lower castes. On the Malabar coast these conditions are reversed, the higher castes being highest in *B*. It is evident that *B* has spread both socially, in different castes, and geographically, and it is suggested that *B* may have spread from a single source in north central India during recent millenniums. In Bengal, the Mohammedan blood groups are similar to those of low-caste Hindus in the same region, which accords with the tradition that they were low-caste converts from Hinduism in Moghul times. The relatively low *B* in Cochin is accounted for by the fact that migratory movements from farther north missed the Malabar coast, the lower castes and pre-Dravidians being high in *A*.

Frequency of Multiple Births

MR. ALBERT V. T. DAY, of 180 Kings Highway, Westport, Connecticut, writes to direct attention to the empirical rule connecting the observed frequencies of twin, triplet and quadruplicate births, namely, that approximately one birth in 80 is of twins, one in 80^2 of triplets, and one in 80^3 of quadruplets. He suggests that the discovery of such a consistent rule in inorganic physics would not be treated as a mere mathematical coincidence. If the said rule is a functional expression of some real biological mechanism, its true basic ratio may be 81, derived as 9^2 or 3^4.

Food Pellets of Owls

BY studying the activities of a captive short-eared owl (*Asio flammeus*), Dennis Chitty has added to knowledge of its food habits (*Proc. Zool. Soc.*, Ser. A, **108**, 267; 1938). The formation of pellets, it is said, is not due to any special diet or structure of the alimentary canal, and Guérin regards their ejection as a deliberate act the time of which is determined at will by the bird. In the short-eared owl the time of ejection of pellets was found to be related to the weight of the meal previously taken, although as a rule pellets were retained longer at night than during the day. At each ejection the owl completely emptied its stomach, the pellet representing the residue of one or two meals of which the combined weight seldom exceeded 40 gm. Biochemical analysis of the food taken by the owl shows that pellet ejection involves a low percentage of ash, and particularly of calcium in the retained food matter. The data gathered in these experiments have been used to estimate the food requirements of an owl in natural conditions (though the results may be considerably off the mark). It is concluded that in a year a short-eared owl would eat more than 47 lb. of voles and mice, and probably more than 95 lb. but less than 142 lb. Where some relationship is known between the size of owl and vole populations in the same area, this represents a consumption of the vole population by owls at a rate of 0·02–0·05 per cent of the population per day—not enough to make any serious impression upon a vole plague.

Moulds of Blue Cheese

MOULD fungi which can grow under the conditions of low oxygen tension provided by the cracks of certain cheeses are somewhat variable, and many species have been described. It was suggested by Thom in 1930 that all these species were really cultural variants of one, namely, *Penicillium roqueforti*. S. Dattilo-Rubbo has re-examined the question in great detail (*Trans. Brit. Mycol. Soc.*, **22**, Pts. 1 and 2, 174–180, Aug. 1938), and his results

substantially confirm those of Thom. A new variety, *viride*, of *P. roqueforti* has been obtained from Blue Cheshire cheese, but this is the only variant of significant permanence isolated from Roquefort, Gorgonzola, Stilton, Blue Vinney, Wensleydale and Blue Cheshire products. Dolce Verde cheese, however, provides an isolated exception, for its organism is related to *P. expansum*, a blue mould associated with the rotting of fruit.

The Pitch-Crust Fungus

A DETAILED paper by W. H. Wilkins (*Trans. Brit. Mycol. Soc.*, 22, Pts. 1 and 2, 47–93; Aug. 1938) gives an account of the spore germination and methods of infection of the common pitch-crust fungus, *Ustulina vulgaris*. This fungus can attack standing timber, and causes subsequent decay. The investigation shows that while spores can germinate upon living trees, penetration is very slow. Dead wood, on the other hand, allows germination and ready penetration, and it is suggested that in Nature the organism is somewhat saprophytic and grows first upon non-living timber. Saturated wood and a temperature above 10° C. for not less than 24 hours are the necessary conditions for spore germination, and the age of the spores is also a potent factor. The optimum temperature for germination is 25–30° C., and the optimum *p*H is 6. Spores germinate upon, and penetrate, ash, beech, elm, horse-chestnut, lime and poplar, but not oak. The collected result of these experiments is, however, considered to suggest the improbability of spore transmission in temperate climates, and other methods must be considered.

New Zealand Forest Fungi

NUMEROUS references to published work upon fungi which attack New Zealand forest trees have been collected by Mr. T. T. C. Birch (*N.Z. J. Forestry*, 4, 2, 1937, or *N.Z. State Forest Service Bull.* 9, 1938). For each fungus species, the New Zealand hosts are given, distribution of the parasite is indicated, a description of the type of damage caused is given, and then the references to published work. It is thus possible to obtain with ease a conspectus of New Zealand forest pathology. Many of the sixty-two species listed are common in Europe, though not always as parasites. *Schizophyllum commune*, for example, is a parasite in New Zealand; but is usually considered a saprophyte in Great Britain. Seven species, the hyphæ of which are probably mycorrhizal, are also mentioned, and beneficial symbiosis of *Boletus luteus* with *Pinus radiata* has been proved by Mr. Birch.

The Earth's Crust

A RECENT paper by Neil R. Sparks ("The Eureka Earthquake of June 6, 1932", *Bull. Seism. Soc. Amer.*, 26, 13–27; 1936) has aroused considerable interest in that the thicknesses of the crustal layers and the velocities of waves in them turn out to be rather different from those determined for Europe. In consideration of this, Stoneley (*Bull. Seism. Soc. Amer.*, 28, 191–195; 1938) has reviewed the observations, determining the standard deviations. He finds the thicknesses of the granitic and second layers to be $12{\cdot}6 \pm 2{\cdot}5$ km. and $12{\cdot}2 \pm 1{\cdot}9$ km., compared with the 16 and 14 km. given in Sparks's paper. The velocities of the *P* waves in these turn out to be $7{\cdot}15 \pm 0{\cdot}065$ and $7{\cdot}53 \pm 0{\cdot}073$ km./sec. respectively, using Sparks's assumptions. The most recent determination by Jeffreys (*Mon. Not. Roy. Astro. Soc.*, Geoph. Supp., 4, 210; 1937) for European earthquakes is 17 ± 2 km. and 9 ± 3 km. for the thicknesses of the granitic and intermediate layers respectively, and P^* is $6{\cdot}498 \pm 0{\cdot}026$ km./sec.

Absorption of the CH_3 Group near 3μ

IN a previous communication (*Proc. Roy. Soc.*, A, 162, 419; 1937), Drs. J. J. Fox and A. E. Martin recorded observations made on the CH vibrations of some organic compounds in the 3μ region. They indicated that, whilst a CH_3 group in general gave rise to two C–H vibration bands, in some molecules, especially those containing a benzene ring, the C–H units interacted to give several bands. Continuing this work, the same authors have examined a large number of compounds containing CH, CH_2, and CH_3 groups arranged in different ways, and a recent paper (*ibid.*, 167, 257–281; 1938) contains details of the absorption in the 3μ region, of seven compounds in which CH_3 groups are attached to the rest of the molecule by single bonds. By reviewing the data available for ethylene, the authors have been able to explain the CH_2 bands observed in more complicated molecules. When only one CH_2 group is contained in the molecule, the two bands observed correspond to the CH valency vibrations in and out of phase; but as the number of CH_2 groups in the molecule is increased, coupling between them causes an increase in the number of bands. Thus dioxan has four strong bands. Using a model of the formaldehyde type, which approximates to the molecules studied, the observed frequencies can be explained assuming that the CH force constant is $4{\cdot}52 \times 10^5$ dynes/cm. It is found that the mass to which the CH_2 group is attached, and the various other force constants involved, have only slight effects on the position of the CH_2 absorption bands in the 3μ region, except in rare instances where the bonds connecting the CH_2 groups to the rest of the molecule are strained. Compounds containing CH_3 and aliphatic CH groups will be dealt with in a forthcoming communication.

Ultra-Rapid Processing of Radiographs

BY ordinary methods of processing, the minimum time between the taking of a radiograph and the viewing of the finished film is about ten minutes. Development takes five minutes and the remaining time is needed for a quick rinse and sufficient fixing to render the film legible. In certain surgical operations—the Smith-Petersen nail operation is a case in point—frequent radiographs are required for inspection during their progress, and the surgeon is held up while these are being prepared. It is now possible by mean of a process devised by Messrs. Kodak, Ltd., to view the films within one minute after exposure. By the use of the new ultra-rapid developer which this investigation has produced, the development of normally exposed films takes only fifteen seconds. A quick rinse of ten seconds in clean water and fixation for thirty seconds in a special bath complete this stage of the process, so that the surgeon's loss of time is greatly reduced. It is stated that films prepared by this special process can be made available for future reference by giving them a final fix in a normal hardening bath and then thoroughly washing them. The radiographic quality of the films produced by this new method compares well with that obtained under the more familiar processing conditions.

Aggregation of Purified Tobacco Mosaic Virus

Dr. Hubert S. Loring, Dr. Max A. Lauffer, and Dr. W. M. Stanley, Rockefeller Institute for Medical Research, Princeton, New Jersey.

THE point of view has been advanced by Bawden and Pirie[1] that purified tobacco mosaic virus consists of stable aggregates of many smaller units present in the infectious tissue extracts. Such aggregation has been stated to take place after purification by chemical means or after high-speed centrifugation, and to result in a decrease in specific activity, in an increase in stream double refraction, and in an inability of the purified virus to pass ultra-filters which readily permit of the passage of crude virus. Similar conclusions have been drawn for purified latent mosaic virus[1]. It was early recognized that prolonged chemical treatment of tobacco mosaic virus with salts at room temperature resulted in a decrease in specific activity[2]. Later, other evidence was secured indicating that aggregation of virus occurred as a result of such treatment; hence there is complete agreement that the rather drastic chemical procedures used by Stanley[3] and by Bawden and Pirie[1] and others for the purification of tobacco and latent mosaic viruses and their strains resulted in aggregation.

Table 1.

Activity and Stream Double Refraction of Tobacco Mosaic Virus after One, Two, Three and Four Sedimentations.

Experiment	Activity*			Stream double refraction†			
	1	2	3	1	2	3	4
Original juice	466	2068	799	14·4	21·0	21·2	18·5
Sedimented and redissolved in supernatant juice	486	2243	798	17·7	19·9	19·5	19·8
Original juice	1152	970	609				
Sedimented and redissolved in water or buffer	1267	988	561	16·7	8·7	13·8	15·8
Twice sedimented virus	1777	2359	1221		18·0		11·0
Three times sedimented virus	2025	2052	1276			25·3	
Once sedimented virus	605	1413					
Four times sedimented virus	533	1163			36·0		27·0

* Activities are expressed as numbers of lesions obtained on 30–40 half leaves of *Phaseolus vulgaris* plants by a 1–2000 dilution in 0·1 *M* phosphate buffer at *p*H 7 for samples of juice and 10^{-4} gm. per c.c. for samples of purified protein.

† Stream double refraction is expressed as the galvanometer deflections in mm. caused by undiluted samples of juice and re-suspended virus or by concentrations of purified virus equal to those of the once sedimented virus redissolved in water.

For this reason, other means for purification were sought by us. Highly active preparations were obtained from the infectious juice of young plants after three or four precipitations of the virus with ammonium sulphate, provided long exposure to the salt was avoided[2]. In more recent work, however, it was found that preparations obtained by means of high-speed centrifugation in the absence of salt possessed a high and uniform specific activity, and this method has been used almost exclusively[4]. It has seemed desirable to examine the nature of such preparations of purified virus in view of Bawden and Pirie's finding that all their purified preparations consisted of aggregated virus and their contention that centrifugation causes such aggregation.

The question of aggregation of tobacco mosaic virus has been studied by comparing the activity, the stream double refraction, and the filterability of virus before and after purification by ultracentrifugation. The virus was sedimented from clarified infectious juice by centrifugation at about 5° for 1½ hours in a field of about 50,000 *g*. To determine the effect of one sedimentation, the virus was redissolved in the supernatant juice from which it had separated, or in the same volume of water or 0·1 *M* phosphate buffer at *p*H 7. The solutions were then centrifuged at low speed to remove a small amount of insoluble material. To obtain more highly purified samples, the once sedimented virus dissolved in water was subjected to one or more additional sedimentations. The activity tests were made on leaves of *Phaseolus vulgaris* L. plants by the half-leaf method[5], and the stream double refraction measurements in the apparatus previously described[6].

The results of the activity and stream double refraction measurements are shown in Table 1. When the sedimented virus was redissolved in the supernatant juice and the activity of the resulting solution was compared with that of the original juice at the same dilution, both sedimented and unsedimented virus produced about the same number of lesions. When the sedimented virus was redissolved in water and compared at the same dilution with the original juice, again comparable numbers of lesions were obtained with both solutions, although the protein concentration of the former was only about 80 per cent that of the juice. As shown in Table 1, the stream double refraction of the once sedimented virus, whether redissolved in the supernatant juice, in water, or in dilute buffer, was about the same as that of the original juice. The combined activity and stream double refraction measurements demonstrate quite conclusively that one sedimentation under the conditions described failed to cause either an appreciable decrease in specific virus activity or an increase in stream double refraction, as would be expected if irreversible aggregation of the original virus had taken place. They also showed that such centrifugation resulted in practically complete sedimentation of the virus. In agreement with this, the supernatant juice which had been poured off contained less than 1 per cent of the original virus activity and showed a negligible amount of stream double refraction.

The results of the activity comparisons and stream double refraction measurements of virus purified by two, three, or four sedimentations are also shown in Table 1. These samples were compared on a protein basis. The activity results are comparable to those found after one sedimentation in that no great change in activity took place after several sedimentations. A comparison of once and four times sedimented virus, however, showed a slight decrease in specific virus activity after four sedimentations. In agreement with this, four times sedimented virus showed a significant increase in stream double

refraction. If this is due to aggregation, then, in view of the activity measurements, the amount must either be relatively small or must be largely reversed at the dilution used for the activity measurements.

The ultrafiltration experiments were carried out in the presence of 0·1 *M* phosphate and nutrient broth at a 1–5 dilution at about *p*H 8 under the conditions used by Thornberry[7]. Ultrafilters of about 190 mμ and 330 mμ average pore diameter, kindly supplied by Dr. J. H. Bauer, were used. In each case the filterability of the virus was determined by comparing the activity of the solution on half leaves before and after filtration. The results are summarized in Table 2. They show that once sedimented virus, redissolved in the supernatant juice, or virus purified by four ultracentrifugations, possessed about the same ability to pass ultrafilters of 190 mμ average pore diameter as the virus in the original juice. Once sedimented virus, as well as clarified infectious juice, could be filtered through filters of 330 mμ average pore diameter without significantly affecting the virus concentrations. The ultrafiltration results are, therefore, entirely comparable with the activity and stream double refraction measurements, except that the small amount of aggregation indicated by the two latter measurements in the case of the four times sedimented virus appears to be insufficient to affect its filterability through membranes of 190 mμ average pore diameter.

Table 2.

Effect of Sedimentation on Ultrafiltration of Tobacco Mosaic Virus.

Virus solution	Dilution*	Average pore diameter (mμ)	Activity†		Per cent virus in filtrate
			Before filtration	After filtration	
Infectious juice	1–100	190	483	203	42
Sedimented virus in supernatant juice	,,	,,	292	307	105
Four times sedimented virus	,,	,,	1038	382	37
Infectious juice	1–100	330	846	665	79
Sedimented virus in water	,,	,,	1782	1700	96
Twice sedimented virus	,,	,,	268	121	45

* Dilutions are in terms of the original juice. The solvent in each case consisted of nutrient broth at a 1–5 dilution in 0·1 *M* phosphate at *p*H 8.

† Number of lesions produced on 24–30 half leaves of *Phaseolus vulgaris* plants.

The results of the three types of experiments described above fail to show an appreciable irreversible aggregation as a result of centrifugation. They are in agreement with the finding of Loring[4] that latent mosaic virus purified by ultracentrifugation readily passed filters of 450 mμ average pore diameter, and the observation[8] that the tobacco mosaic virus nucleoprotein in clarified juice and that purified by ultracentrifugation have the same sedimentation constant. The latter observation, as has been shown by Lauffer[9] from theoretical considerations, indicates that the size and shape of the particles of purified virus are the same as those of the virus particles in the juice. It is improbable that virus in untreated juice is in the form of prismatic plates as suggested by Bernal[10], for it has already been demonstrated that such virus consists of rod-like particles[6,11]. Recent work indicates that tobacco mosaic virus has a molecular weight of at least 43×10^6, a length of at least 430 mμ, and an effective diameter[9] of about 12 mμ.

The results obtained in the present work fail to confirm Bawden and Pirie's[1] report that one sedimentation causes great increase in stream double refraction, and indicate that tobacco mosaic virus purified by a few careful centrifugations is comparable in specific activity, in stream double refraction, and in filterability to the virus in untreated juice. In view of unpublished observations that isoelectric precipitation or precipitation by means of ammonium sulphate at room temperature causes a loss of specific activity and an increase in stream double refraction of ultracentrifugally isolated virus, it is evident that the virus first isolated by chemical means, as well as preparations obtained later by us and by others by means of prolonged chemical treatment at room temperature, consisted largely of aggregated virus. Preparations obtained by rapid chemical treatment in the cold or preferably by means of ultracentrifugation in the cold appear to be the only ones yet obtained that are comparable to the virus in untreated juice with respect to specific activity, filterability and stream double refraction.

[1] Bawden, F. C., and Pirie, N. W., *Proc. Roy. Soc.*, B, **123**, 274 (1937); *Brit. J. Exp. Path.*, **19**, 66 (1938).

[2] Loring, H. S., and Stanley, W. M., *J. Biol. Chem.*, **117**, 733 (1937).

[3] Stanley, W. M., *Science*, **81**, 644 (1935); *Phytopathology*, **26**, 305 (1936).

[4] Stanley, W. M., and Wyckoff, R. W. G., *Science*, **85**, 181 (1937); Stanley, W. M., *J. Biol. Chem.*, **121**, 205 (1937); Loring, H. S., and Wyckoff, R. W. G., *J. Biol. Chem.*, **121**, 225 (1937); Price, W. C., and Wyckoff, R. W. G., Nature, **141**, 685 (1938); Loring, H. S., *J. Biol. Chem.*, **126** (1938).

[5] Loring, H. S., *J. Biol. Chem.*, **121**, 637 (1937).

[6] Lauffer, M. A., and Stanley, W. M., *J. Biol. Chem.*, **123**, 507 (1938); Lauffer, M. A., *J. Phys. Chem.*, **42** (1938).

[7] Thornberry, H. H., *Phytopathology*, **25**, 938 (1935).

[8] Wyckoff, R. W. G., Biscoe, J., and Stanley, W. M., *J. Biol. Chem.*, **117**, 57 (1937).

[9] Lauffer, M. A., *J. Biol. Chem.*, **126** (Nov. 1938); *Science*, **87**, 469 (1938); Lauffer, M. A., and Stanley, W. M., *Chem. Rev.*, **24** (April 1939).

[10] Bernal, J. D., *Proc. Roy. Soc.*, B, **125**, 299 (1938).

[11] Takahashi, W. N., and Rawlins, T. E., *Science*, **77**, 26, 284 (1933); **85**, 103 (1937).

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When we found that the infectivity and filterability of preparations of tobacco mosaic virus were reduced and the anisotropy of flow was increased by chemical methods of isolation, we suggested that linear aggregation had taken place[1,2]. This is now confirmed by Loring, Lauffer and Stanley, but they claim that unaggregated preparations can be made by the use of a high-speed centrifuge. We found that sedimenting the virus increased anisotropy of flow, but we made no measurements of the effect on infectivity or filterability. It was suggested by analogy with the chemically prepared virus that this effect was also a result of aggregation. There is no necessary contradiction between our observations and those of the American workers. We centrifuged for 3 hours at 25–30° C., whereas they used a more efficient centrifuge running at 5° C.; furthermore, their measurements of anisotropy of flow were made at very much higher rates of shear[3] than were ours. A lengthening of the virus rod would be expected to increase the readiness with which anisotropy of flow would be demonstrated rather than the total amount shown, and the changes which we have claimed might well be undetectable by their method.

Even if centrifugation does not cause aggregation, completely unaggregated preparations could be expected only from plants that have been recently infected, for aggregation occurs naturally in the sap of plants that have been long infected[4].

We have emphasized the need for caution in interpreting centrifugal data on systems which can, in some circumstances, aggregate. It may be possible to isolate unaggregated tobacco mosaic virus by short periods of centrifuging in strong gravitational fields at a low temperature. But it is significant that four sedimentations cause an increase in anisotropy of flow detectable by the method of Loring, Lauffer and Stanley. It therefore seems improbable that one sedimentation should have no effect. Also, until more adequate data on the activity, chemical composition and physical properties of virus preparations made solely by high-speed centrifugation have been published, it will not be possible to assess their purity.

[1] Bawden, F. C., and Pirie, N. W., *Proc. Roy. Soc.*, B, **123**, 309 (1937).
[2] Bawden, F. C., and Pirie, N. W., Reunion Inter. de Physique, Chimie et Biologie (Paris, 1937), p. 382
[3] Lauffer, M. A., and Stanley, W. M., *J. Biol. Chem.*, **123**, 507 (1938).
[4] Wyckoff, R. W. G., *J. Biol. Chem.*, **121**, 219 (1937).

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DR. STANLEY and his colleagues draw the conclusion that tobacco mosaic virus is not aggregating after centrifugation since it passes a membrane of 190 mμ average pore diameter. In our ultrafiltration experiments, we have found that this virus, after precipitation at *p*H 3·4, will pass through a membrane of smaller pore size than the foregoing and has an end-point under optimum conditions of 150–175 mμ. This indicates an aggregation of some kind, since the accepted ultrafiltration end-point of tobacco mosaic virus in crude clarified sap is about 50 mμ. In our opinion, therefore, it is not justifiable to draw the conclusion that the virus is not aggregated merely because it passes a membrane of 190 mμ average pore diameter. Tobacco mosaic virus, however, which has been subjected to the full process of purification and will therefore take up the liquid crystalline state, has a filtration end-point greater than 450 mμ; it is clear, therefore, that intermediate stages of aggregation are possible.

Origin of the Solar System

THE presidential address to the British Astronomical Association was delivered by Rev. Dr. M. Davidson, on October 26, at Zion College, and dealt with the theories advanced to explain the system of planets and satellites of the solar system.

After brief reference to certain electric theories, in particular to that of H. P. Berlage, which appeared in *Prof. Roy. Acad. Amsterdam* in 1930–34, other theories which have held the field for a time were discussed. The main objection to the old and rather attractive Laplacian hypothesis is the enormous discrepancy between the angular momentum that the rotating nebula must have possessed and that which the solar system possesses to-day. Further, the theory suggested that the planets were thrown off from the original sun by internal forces and were not removed by some outside agency; but, as the major planets have about 98 per cent of the angular momentum of the solar system and only about 1/700 of the total mass, this suggests the action of an external body.

The planetismal hypothesis of Chamberlin and Moulton did not receive so much attention in Great Britain as might have been expected. The manner in which the planets were formed, according to this hypothesis, differs essentially from that which the more recent tidal theory assumes. In the former case, they are assumed to have been built up slowly by accretions drawn into the original nuclei; in the latter case the once liquid planets received very little later accretions. The difference may not be of much interest to an astronomer but to the geologist it is of the utmost importance.

The planetismal hypothesis is the parent of the more recent tidal theories, and naturally many of the objections to the latter will also apply to the former. Dealing with Sir James Jeans's theory, which first assumed a very extensive sun but later adopted the 'Roche model'—a body with a strong central condensation—Dr. Davidson referred to a number of objections to the theory. The greatest of these, he believes, is that which arises from a consideration of the distribution of angular momentum in the planets, per unit mass, as pointed out by Prof. H. N. Russell. The visiting star which was supposed to have produced the eruption from our sun must have made a very close approach, and, even under the most favourable conditions, it could not have produced ten per cent of the angular momentum per unit mass that the planets possess at present. This seems to be sufficient, without any other objections, to condemn the theory.

The recent theory of Dr. R. A. Lyttleton was then dealt with. This starts with the assumption that the sun was once a binary and that its companion was ejected by a visiting star, the filament formed by the usual disruption, which is supposed to occur in these cases, finally producing the planets and satellites, the latter by close approaches of planets. However, as Dr. H. Jeffreys has shown, the satellites could not have been formed in the manner assumed, and Dr. Lyttleton was forced to abandon his original explanation of these bodies, and to assume rotational instability of enormous primitive planets. Jupiter and Saturn, according to this theory, were once a single extensive planet, and from the filament resulting from the disruption their satellites were formed, and even other independent planets. His explanation of the origin of the primitive planets was severely criticized by Dr. W. J. Luyten and Dr. E. L. Hill. In particular, they had shown that the visiting star, which must have removed the filament from the companion at least 20 astronomical units from the sun (half the distance of Pluto), required a velocity of about 100 km. a second, and at such a distance from the sun the matter would escape. There are other objections, and Dr. Lyttleton, recognizing the validity of these, has modified the

theory in one respect especially. If the visiting star is greater than the companion of the sun, the conditions would obviously be more favourable, but, on the whole, it seems extremely doubtful if an explanation will be found along these lines. Dr. Davidson is of opinion that some much simpler explanation, not demanding so many *ad hoc* assumptions, would be forthcoming, but this might be a long way off yet.

In conclusion, Dr. Davidson referred to the new satellites of Jupiter and to the fact that Mr. J. Miller had predicted a missing satellite (NATURE, Feb. 5, p. 245). Unfortunately, satellite x, for which an orbit had been computed, did not fit into the place predicted for it, as it was 7 million miles from Jupiter. He felt, however, that there was a space about 2½ million miles from Jupiter in which a satellite would some day be discovered. The fact that satellites vi, vii, and x are moving in similar orbits at nearly the same mean distances from their primary provides another problem for the cosmogonist. Perhaps a shoal of minute bodies occupies this region, but naturally one can only conjecture on such matters.

At the close of the address, Dr. Davidson vacated the presidential chair, which was then taken by Mr. B. M. Peek, the newly elected president.

Removal of Sulphur Acids from Flue Gases

IN Great Britain there is manufactured annually about one million tons of sulphuric acid, but a quantity of sulphur oxides much greater than this is discharged into the atmosphere by the combustion of coal. In the last ten years, it has become possible to reduce atmospheric pollution from this source. The concentration of sulphur oxides in chimney gases is very low and so long as fuel-consuming units were small and scattered, the resulting damage was relatively inconspicuous. Moreover, any effective process for desulphurizing the gas would have been prohibitive in cost. Engineers limited their efforts to reducing the visible pollution by smoke and grit.

Technical developments in the generation of electricity compelled attention to the problem of cleaning flue gas. Mechanical stoking made it possible to burn fine coal at high rates of combustion and caused the discharge of much grit and dust into the atmosphere. The introduction of pulverized fuel accentuated the grit nuisance. Economy of steam production and power generation was secured by working in ever larger units and the need for reducing the high cost of distributing electricity required that these units should be installed near the load. The result has been the erection of huge coal burning units using inferior coal in large centres of population. With the project to erect the generating station at Battersea, the danger of discharging large quantities of sulphur acids into the heart of London was recognized, and the London Power Company was compelled to render its chimney gases innocuous before passing into the air. Now the concentration of coal burning into large units, while increasing the local intensity of atmospheric pollution, eased the technical problem of designing and operating economic processes of sulphur removal. In a relatively short time, the Battersea station was discharging into the air, flue gases almost free from sulphur. The gases, before entering the chimney, were washed with large volumes of Thames water to which lime was added and the clarified effluent returned to the river.

When the Fulham Power Station came to be enlarged, the authorities were able to insist that a similar standard of purity should be maintained; but in addition, that no effluent should be returned to the Thames, lest the alkalinity of the river water, already diminished by the Battersea plant, should be destroyed. The very existence of the Fulham plant was thus dependent on devising a process which made no liquid effluent. The wash liquor would inevitably become saturated with salts which must be removed as fast as made. The salt in this case was calcium sulphate, which is prone to form a troublesome scale on surfaces and in a continuous process liable to block the plant.

In an address delivered at a recent meeting of the London Section of the Society of Chemical Industry, Dr. R. Lessing described the course of experiments which showed how the salt could be removed without scale formation. Calcium sulphate solutions can persist in a super-saturated state; but this condition can be prevented if the wash liquor contains sufficient $CaSO_4.2H_2O$ on suspension. It was found possible to define conditions under which the flue gases could be washed continuously with a liquor, containing in suspension about 10 per cent of $CaSO_4$ and working in a closed cycle. Water removed by evaporation up the chimney was replaced and fresh lime was added to replace that removed by precipitation of lime salts. An essential feature in the cycle was a 'delay' tank where the 'desupersaturation' of the liquor could proceed to a point where deposition of scale in the plant would not occur.

This process has now been in operation at Fulham and elsewhere long enough to leave no doubt that gases can be discharged from chimneys practically free from sulphur acids without the production of a liquid effluent. An important advantage of a washing process is the simultaneous removal of grit. Mechanical methods of removing grit are only partially successful. The electrostatic precipitator can retain grit almost completely, but allows acid gases to pass into the air. Moreover, the electrostatic precipitator is not certain under overload conditions such as arise when "soot blowing" is in progress.

The cost of sulphur extraction during the first year's working at Fulham was 0·0144*d.* per unit, and will doubtless be reduced with further experience. This may be a price well worth paying to reduce the damage due to sulphur in urban atmosphere. Dr. Lessing said that the washing of the chimney gases at Battersea and Fulham would eventually mean a reduction of sulphur pollution in the London area amounting to ten per cent. This shows the importance of this striking success of chemical engineering.

H. J. HODSMAN.

American Association for the Advancement of Science

Virginia Meeting

THE American Association for the Advancement of Science meets in Richmond for its first Virginia convention on December 26–31.

On Monday evening, December 26, at the John Marshall Hotel, editors of all Virginia newspapers, members of the National Association of Science Writers, prominent officials of the State and of the American Association and others will be entertained at dinner by members of the local Virginia Section of the American Chemical Society planning committee, headed by Lloyd C. Bird. Sir Richard Gregory, editor of NATURE, is to be the principal speaker. Austin H. Clark, curator of the Division of Echinoderms at the Smithsonian Institution and formerly director of the press service for the Association, will be honoured at this meeting for his long service and untiring co-operation with the Press of the world in helping to make available scientific news for the public.

Dr. George D. Birkhoff, professor of mathematics at Harvard University and retiring president of the Association, will be the principal speaker at a general session on Tuesday night at the Mosque. His subject will be "Intuition, Reason and Faith in Science". Dr. Wesley C. Mitchell, professor of economics at Columbia University and president of the Association, will preside. The address will be followed by a reception by the local committee to the Association and guests at the Thomas Jefferson Hotel.

The joint session of the Society of the Sigma Xi and the Association will be held on Wednesday night at the Mosque with Dr. W. F. Durand, emeritus professor of engineering at Stanford University, as the principal speaker. Dr. Durand is a past president of Sigma Xi, the leading honorary scientific fraternity of the United States and a member of the National Committee for Aeronautics. His subject for the seventeenth annual Sigma Xi lecture will be "Modern Trends in Air Transport".

On Thursday evening there will be a joint general session of the United Chapters of Phi Beta Kappa and the American Association at the Mosque. The lecturer will be Dr. Frank Pierrepont Graves, New York State Commissioner of Education, and his subject will be "Is Education a Science?"

The mental health symposium, one of the features of the meeting, will end on Friday night with a general session at the Mosque. Dr. C. Macfie Campbell, professor of psychiatry at Harvard Medical School, will be the principal speaker.

As a contribution to the general public, members of the local planning committee are arranging a public meeting at the Mosque for either Saturday afternoon or evening with Dr. William M. Mann, director of the National Zoological Park, Washington, D.C., as the speaker. Dr. Mann has kindly consented to show and explain his motion pictures taken in Sumatra during an expedition for specimens for the National Zoo. This motion picture and Dr. Mann's address will be one of the principal features for the public during the meeting.

In order to commemorate the outstanding work of Virginia's first State geologist, W. B. Rogers, after whom Mount Rogers in Southwest Virginia is named, on the occasion of the Virginia meeting of the American Association, the Virginia Section of the American Chemical Society has organized a tour to include a visit to White Top and Mount Rogers in picturesque southwest Virginia. The erection of a tower of native rock on top of Mount Rogers, which would give visitors and pilgrims to this beauty spot a view of five States, is one of the proposals for the memorial. Prof. Rogers, a graduate of the College of William and Mary, where his father was a professor, was appointed professor of natural philosophy at the University of Virginia, and first State geologist in charge of the Virginia Geological Survey in 1835. His work brought him national recognition as a leading Virginia man of science, and created a general appreciation of that day of the scientific possibilities in Virginia. Dr. Rogers helped in the formation of the Association of American Geologists and Naturalists. He was elected president of the Association in 1848, when it was transformed into the American Association for the Advancement of Science, and in 1876 became president of the latter body.

Laboratory of Saharan Biology

THE extent of investigations carried out by the French in the Sahara is well known to the British scientific world, and not a few British biologists have made that desert a field of their researches. In the past, such explorations have had to take the form of more or less arduous expeditions, which prevented more lasting observations requiring a convenient and suitably equipped base. The need of establishing such a base was recognized by French authorities some years ago, and all biologists interested in desert life will be glad to know of the existence of a Laboratory of Saharan Biology (Laboratoire de Biologie Saharienne) at Beni-Ounif, in the south of the Oran province of Algeria and on the border of French Morocco.

The Laboratory occupies an old fort, which was abandoned as it had lost its military importance, and comprises several rooms with the necessary furniture and scientific equipment. In a village which has grown around the fort one can obtain all the necessities of life, while its relatively small size enables one to reach unspoilt desert by a short walk. The environs of Beni-Ounif are exceptionally interesting for a biologist, since most of the types of desert environment can be found within easy distance: *reg* (hard, pebbly desert), *hammada* (stony desert), *erg* (sand-hills), *oueds* (dry water-courses) and a large oasis with date cultivation. The Laboratory presents unique facilities, by its situation and equipment, for investigations on various problems of the ecology of

desert plants and animals, which can be attacked by direct observation in the field combined with experiments on fresh material in the Laboratory.

Owing to insufficient publicity, the Laboratory has remained hitherto practically unknown to biologists outside France, and it is to be hoped that this note will attract the attention of biologists who may wish to work on desert biology, but believe that this must necessarily involve the discomforts of travelling and camping. Beni-Ounif is reached by train from Oran or Algiers in seventeen hours, and inexpensive accommodation can be found in one of the several local hotels. Foreign research students are very welcome, and no charge is made for the use of the Laboratory. Detailed information can be obtained from the director of the Laboratory, Prof. Ch. Killian, Faculté des Sciences, Algiers, Algeria.

B. P. Uvarov.

University Events

Cambridge.—In accordance with its usual practice, Trinity College announces the offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year. Candidates must not have reached the age of twenty-six years before May 1, 1939. In certain circumstances, an election may be made to an additional studentship. The same College offers, as usual, Dominion and Colonial exhibitions to students of Dominion and Colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of £40; but their actual value varies. Further particulars may be obtained from the Senior Tutor, Trinity College, Cambridge.

E. Rothbarth has been appointed assistant in statistical research.

The degree of master of arts has been conferred upon Dr. J. E. Driver (London), University demonstrator in chemistry.

At Emmanuel College, Dr. G. R. Owst, professor of education, has been elected into a professorial fellowship.

Prof. R. G. W. Norrish has been elected a member of the Council of the Senate.

London.—Dr. H. S. W. Massey, who has been since 1933 independent lecturer in mathematical physics in the Queen's University, Belfast, has been appointed as from January 1 to the Goldsmid chair of mathematics tenable at University College.

The Chester Beatty scholarship in radiology of the value of £400 for one year has been awarded to Mr. E. P. Allen. This scholarship was established through the generosity of Mr. A. Chester Beatty for two years to enable students to study radiology in the United States.

The John Marshall fellowship of the value of £500 a year for two years has been awarded to Mr. K. C. Eden. This fellowship was established under the will of the late Miss A. B. Marshall in memory of her father, Prof. John Marshall.

The following doctorates have been conferred: D.Sc. in biochemistry on J. F. Danielli; D.Sc. in botany on Miss Ann C. Halket; D.Sc. (engineering) on Prof. J. T. MacGregor-Morris.

Science News a Century Ago

Royal Astronomical Society

On November 5, 1838, at a meeting of the Royal Astronomical Society, a letter written on October 23 from Königsberg by Bessel to Sir John Herschel was read, describing his efforts to determine the parallax of a fixed star. Bessel began his letter: "Esteemed Sir,—Having succeeded in obtaining a long-looked-for result, and presuming that it will interest so great and zealous an explorer of the heavens as yourself, I take the liberty of making a communication to you thereupon. Should you consider the communication of sufficient importance to lay before the other friends of astronomy, I not only have no objection, but request you to do so. With this view, I might have sent to you through Mr. Baily; and I should have preferred this course, as it would have interfered less with the important affairs claiming your immediate attention on your return to England. But, to you, I can write in my own language, and thus secure my meaning from indistinctness."

Bessel then went on to describe how, to attempt the determination of the parallax of a star, he thought of using Fraunhofer's heliometer, why he chose 61 *Cygni*, and the course of his observations which were begun in September 1824. After having his heliometer repaired, he resumed the inquiry and in March 1840 terminated a series of 402 measures.

Botanical Society of Edinburgh

At a meeting of the Botanical Society of Edinburgh on November 8, 1838, Prof. Graham read an account of a visit which he, along with some friends, had paid to the west of Ireland in August, to examine its botanical productions. It was stated that the mountains of Cunna mara (*sic*) present very little of the alpine vegetation with which the mountains of Scotland are clothed, a difference probably arising from their structure; the summits, or nearly two thirds of their height being composed of the most unproductive quartz. Near the base of the mountains some micaceous soil exists, and there a little alpine vegetation was found. The only peculiarity which the quartz presented was abundance of *Saxifraga umbrosa* (*athenæum*).

Prof. Robert Graham was born at Stirling on December 7, 1786, and died at Coldoch in Perthshire on August 7, 1845. After practising medicine in Glasgow, he was appointed professor of botany in the University of Glasgow in 1818, being the first occupant of the chair. Two years later he was transferred to the chair of botany at Edinburgh, which he held until his death.

The Australian Museum

"It would not be easy to imagine", said the *Mechanics' Magazine* of November 10, 1838, "a more gratifying evidence of a young colony's progress in civilization than that which is given by a handsome volume, a few copies of which have lately reached this country. The book is 'A Catalogue of the Specimens of Natural History and Miscellaneous Curiosities deposited in the Australian Museum'. It is very handsomely printed 'by James Tegg and Co., at the Atlas Office, George-street Sydney', an offshoot from the well-known 'Thomas Tegg, at the Old Mansion House, Cheapside, London'."

Societies and Academies

Paris

Academy of Sciences (*C.R.*, 207, 549–603, Oct. 3, 1938).

M. Molliard : The complete cycle of development of certain phanerogams in aseptic cultures. Radish, stitchwort and ivy-leaved toad-flax among others, can be grown from the seed, produce flowers and set good seeds, inside sterile tubes closed by plugs permitting exchange of gases only. It is proposed to study the inheritance of acquired characters shown by such plants.

H. Lagatu and L. Maume : Does the NPK [nitrogen, phosphorus, potassium] content of leaves of a branch of an Aramon vine differ according as the branch bears more or less fruit ?

J. Shohat (Chokhate) : Generalized orthogonal polynomials.

H. Cartan : Cousin's first problem.

A. Edrei : Recurring determinants and the singularities of a function given by its development by Taylor's method.

C. Jacob : Formation of the complex potential of plane flow in a liquid in a multiply connex domain.

D. Avsec : Thermo-convectional turbulence and the condensation of water vapour.

T. V. Ionescu : Coupling an oscillating circuit with a Geissler tube.

P. Duquénois : Complex structure of tartar emetic.

M. Chêne : Preparation of iron phosphides by fusion electrolysis [of iron oxides and sodium phosphates].

P. Ehrenfest, jun. : Loss of energy of cosmic radiation penetrating a screen of 9 cm. of gold.

M. Prettre : Mechanism of the abnormal influence of temperature on the oxidation of mixtures of oxygen or air and hydrocarbons.

E. Cornec and H. Muller : Cryoscopy of salt solutions. While the use of a salt solution in place of water facilitates the determination of molecular lowering of freezing point, the lowering of eutectic points is necessary to find readily the number of ions in the electrolyte studied.

Mme. Z. Soubarew-Chatelain : Absorption spectra by reflection in the ultra-violet of some molybdenum compounds in the solid state.

Y. Ta : Influence of non-polar solvents on the infra-red absorption bands (CH) : application to the molecules $CH_2X—CH_2X$.

C. Dufraisse and P. Compagnon : Dienic syntheses starting from diphenylisobenzofuran : new synthesis of tetraphenylnaphthacene (rubrene).

E. Legé : Transformation of oily substances [from plants] into mixtures of hydrocarbons.

G. Deflandre : Dinoflagellate microplankton preserved in the bituminous Kimmeridigian schists of Orbagnoux (Jura).

A. Brunel and R. Echevin : The glycolic ureides in the development of the flower and fruit of *Acer pseudoplatanus* L.

M.-M. Janot and P. Gonnard : Methoxyl index of some gums and in particular of gum arabic and gum tragacanth.

P. Chouard : Nature of the excitation by hetero-auxins in provoking the formation of roots or of buds at any point on leaf cuttings. The first effect is an unorganized tumour, due to the hetero-auxins, serving as a depot of metabolic products. Differentiation follows and is due to other factors.

Tchou-Su : Germinal localization in the unfertilized egg of anurans.

G. Sandor and J. Tabone : Existence of unstable acetyl functions in the proteins of horse serum.

Moscow

Academy of Sciences (*C.R.*, 19, No. 9, 1938).

I. Chlodovsky : The problem of moments and the polynomes of S. Bernstein.

I. Privalov : Limited values of an analytical function.

B. Segal : New type of diophantic approximations.

M. A. Sabiroff : Remarks on the article by B. D. Kaminsky.

L. Magnaradze : Solution of the fundamental problems of plane theory of elasticity in the case of contours with corners.

B. G. Fessenkoff : Origin of the zodiacal light.

D. Iwanenko and A. Sokolow : Some remarks on the equations of the theory of showers.

A. Seidel and J. Larionov : Nature of the narrow absorption bands in solutions of praseodymium salts.

M. Veingerov : A method of gas analysis based on the optico-acoustic phenomenon of Tyndall-Roentgen.

N. Mihal : Determination of differences between equatorial and meridional gravity moments of the earth by observations of gravitation.

J. B. Zeldovich and D. A. Frank-Kamenetckij : Theory of uniform flame propagation.

J. B. Zeldovich and B. I. Jacovlev : Thermal explosion of nitrous oxide.

L. H. Freidlin and A. I. Lebedeva : Interaction of sodium amide with salts of formic acid.

V. A. Plotnikov : Non-aqueous solutions.

I. I. Kitaigorodsky : Self-hardening as a method of increasing the strength of glass.

V. Porfiryev : Deep-seated tectonics of the Caspian lowland.

V. A. Vakhrameev and D. M. Rauzer-Chernousova : The Middle-Carboniferous in the north-eastern part of the region adjoining Lake Balkhash.

I. D. Sedlezkij : Soil colloidal minerals of the aluminium hydroxide group.

G. M. Litver : Observations on specific sensitivity to radiant energy in oocysts of Coccidia of rabbits.

V. I. Patrushev : Differences in blood composition in cattle, yaks and their hybrids.

S. I. Alikhanian : (1) Bristle mutation (hairy wing) in *Drosophila melanogaster* as a possible duplication. (2) Influence of the *Y*-chromosome upon variability in *Drosophila melanogaster*.

E. I. Jakimova : Dihaploid hybrids *Triticum durum* Desf. × *T. vulgare* Host.

H. F. Kushner : The connexion between heterosis in mules and their blood composition.

B. S. Moshkov : Photoperiodism and immunity.

V. G. Alexandrov and O. G. Alexandrova : Structure of couch-grass grain.

I. V. Kozhanchikov : Peculiarities of gaseous metabolism in insect tissues.

A. I. Irikhimovich : Age-unconformable transplantations of extremities in tadpoles and axolotls.

A. Borissiak : Contribution to the phylogeny of Dicerorhinæ.

J. A. Efremov : Some new Permian reptiles from the U.S.S.R.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 7

University College, London, at 5.—Dr. J. F. Danielli: "The Permeability of Membranes" (succeeding lectures on November 14 and 17).*

University of Leeds, at 5.15.—Dr. H. Spencer Jones, F.R.S.: "Solar and Terrestrial Relationships".*

Royal Geographical Society, at 8.30.—Miss G. Caton-Thompson: "Climate, Irrigation, and Early Man in the Hadhramaut".

Tuesday, November 8

Royal College of Physicians, at 5.—Dr. Harold Scott: "Conquest of Disease in the Tropics" (Fitzpatrick Lectures. Succeeding lecture on November 10).

Chadwick Public Lecture (at the Royal Society of Tropical Medicine and Hygiene), at 5.30.—Sir Stanley Woodwark: "The Rise and Fall of certain Diseases concurrent with the Progress of Sanitation and Hygiene".*

University College, London, at 5.30.—Prof. P. Pruvost: "Some Problems of Sub-Surface Geology in Northern France" (succeeding lecture on November 10).*

King's College, London, at 8.30.—Prof. A. Dalcq: "The Formation of the Pronephros and its Causes".*

North-East Coast Institution of Shipbuilders and Engineers, Newcastle-on-Tyne.—Sir William Bragg, Pres.R.S.: "The Molecular Basis of the Strength of Materials" (Andrew Laing Lecture).

Thursday, November 10

Royal Society, at 4.30.—Prof. E. D. Adrian, F.R.S.: "Some Problems of Localisation in the Central Nervous System" (Ferrier Lecture).

London School of Economics, at 5.—W. G. Eady: "The Care of the Unemployed" (succeeding lecture on November 11).*

Friday, November 11

Physical Society (at the Imperial College of Science), at 5.15.—Prof. A. V. Hill, F.R.S.: "The Transformations of Energy and the Mechanical Work of Muscles" (Guthrie Lecture).

Royal Institution, at 9.—Sir William Bragg, Pres. R.S.: "Combination Tones in Sound and Light".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Lecturer (woman) in Mathematics in the Froebel Educational Institute Training College for Teachers, Grove House, Roehampton Lane, S.W.15—The Principal (November 8).

Director of the Imperial Bureau of Forestry—The Secretary, Executive Council of the Imperial Agricultural Bureaux, 2 Queen Anne's Gate Buildings, London, S.W.1 (November 15).

Four Assistants (grade III) for work on aeronautical electrical equipment at the Royal Aircraft Establishment, South Farnborough—The Chief Superintendent (November 18).

Assistant Lecturer and Demonstrator in Zoology and Comparative Anatomy in University College, Cardiff—The Registrar (November 19).

Lecturer (Chemistry) in the Department of Pure and Applied Science in Loughborough College, Leicestershire—The Registrar.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne for the Year 1937-38, intended to be presented at the Annual Meeting of the Society, 31st October 1938. Pp. 48. (Newcastle-upon-Tyne: Natural History Society.) [1710

Colonial Office. Pitcairn Island. General Administrative Report, by J. S. Neill; Medical Report, by Dr. Duncan Cook. Based on Enquiries made during thirty-nine days residence on the Island between the 15th May and the 23rd June 1937. (Colonial No. 155.) Pp. 79. (London: H.M. Stationery Office.) 1s. 3d. net. [1810

Other Countries

Canada: Department of Mines: Bureau of Economic Geology, Geological Survey. Memoir 199: Lake Etchemin Map-Area, Quebec. By Carl Tolman. (No. 2424.) Pp. ii+20. (Ottawa: King's Printer.) 10 cents. [1710

Fiskeridirektoratets Skrifter. Serie Havundersøkelser, Vol. 5, No. 6: The North Atlantic Halibut and Net Fishing. By Finn Devold. Pp. 68. Serie Teknologiske Undersøkelser, Vol. 1, No. 2: Virkningen av fryschastighet, lagringstemperatur og råstoffets friskhet på kvaliteten av frossen fisk. Av Olav Notevarp og Eirik Heen. Pp. 30. (Bergen: A/s John Griegs Boktrykkeri.) [1710

Department of Agriculture: New South Wales. Veterinary Research Report, No. 7, 1937. By Wm. L. Hindmarsh. Pp. 125+3 plates. (Sydney: Government Printer.) [1710

Catalogue of Foreign Scientific Serial Publications in the various Institutions in Japan. Third edition. Pp. viii+25+825. (Tokyo: National Research Council.) [1710

U.S. Department of the Interior: Office of Education. Bulletin, 1938, Misc. No. 2: To Promote the Cause of Education. Pp. 88. 20 cents. Bulletin, 1938, No. 3: Nature and Use of the Cumulative Record. By David Segel. Pp. v+48. 10 cents. (Washington, D.C.: Government Printing Office.) [1810

Bulletin of the American Museum of Natural History. Vol. 74, Art. 6: Fossil Mammals from Burma in the American Museum of Natural History. By Edwin H. Colbert. Pp. 255-436. (New York: American Museum of Natural History.) [1810

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 30: Reports of the Field Branch for the Year 1937. Pp. iii+171. 50 cents. Annual Report on the Departments of Agriculture, Malaya, for the Year 1937. By O. T. Faulkner. Pp. ii+81. 1 dollar; 2s. 4d. (Kuala Lumpur: Department of Agriculture.) [1810

Union of South Africa: Department of Mines. Geological Series. Bulletin No. 11: Vermiculite Deposits in the Palaboroa Area, N.E. Transvaal. By C. M. Schwellnus. Pp. 27. (Pretoria: Government Printer.) 6d. [1810

Indian Central Cotton Committee. Annual Report of the Director, Technological Laboratory, for the Year ending 31st May 1938. Pp. 42. (Bombay: Indian Central Cotton Committee.) 6 annas. [1810

Advisory Committee on Education. Staff Study No. 11: Library Service. By Carleton B. Joeckel. Pp. viii+107. 15 cents. Staff Study No. 13: The National Youth Administration. By Palmer O. Johnson and Oswald L. Harvey. Pp. x+121. 15 cents. (Washington, D.C.: Government Printing Office.) [1810

Journal of the Indian Institute of Science. Vol. 21A, Part 8: Contributions to the Study of Spike Disease in Sandal (*Santalum album* Linn.). Part 19: Physiological and Physical Methods of Characterising the Disease. By A. V. Varadaraja Iyengar. Pp. 89-102. 1.2 rupees. Vol. 21A, Part 9: Studies on the Chemical Composition and Physical Properties of Plant Tissue Fluids. Part 2: Effect of Mineral Fertilisers on the Tissue Fluids of Ragi (*Eleusine coracana*, Linn.). By S. Rajagopal and A. V. Varadaraja Iyengar. Pp. 103-114. 1 rupee. Vol. 21A, Part 10: Attempts towards the Synthesis of Cantharidin, Part 2. By P. C. Guha and B. H. Iyer. Pp. 115-118. 8 annas. Vol. 21A, Part 11: Reactions of Chromates at High Temperatures. Part 4: Decomposition of Mixtures of Calcium Chromate with Calcium Carbonate. By V. T. Athavale and S. K. K. Jatkar. Pp. 119-130. 1 rupee. Vol. 21A, Part 12: Utilisation of Myrobalans. Part 1: Preparation and Purification of Myrobalan Extract. By S. R. Sunthankar and S. K. K. Jatkar. Pp. 131-148. 1.4 rupees. Vol. 21A, Part 13: Utilisation of Myrobalans. Part 2: Myrobalan Oil. By S. R. Sunthankar and S. K. K. Jatkar. Pp. 149-152. 8 annas. Vol. 21A, Part 14: Utilisation of Myrobalans. Part 3: Utilisation of Myrobalan Extract for the Preparation of Ink and for Cotton Dyeing. By S. R. Sunthankar and S. K. K. Jatkar. Pp. 153-158. 10 annas. Vol. 21A, Part 15: Reactions of Chromates at High Temperatures. Part 5: Decomposition of Strontium Chromate. By V. T. Athavale and S. K. K. Jatkar. Pp. 159-168. 14 annas. Vol. 21A, Part 16: Rotary Drilling Mud. Part 1: The Effect of Tannin on the Viscosity. By P. Y. Narayana. Pp. 169-178. 14 annas. Vol. 21A, Part 17: Reactions of Chromates at High Temperatures. Part 6: Decomposition of Mixtures of Strontium Chromate and Strontium Carbonate. By V. T. Athavale and S. K. K. Jatkar. Pp. 179-188. 14 annas. Vol. 21A, Part 18: Electrometric Titration of Tannic Acids. Part 1: Electrometric Titration of Ellagic, Elliagitannic and Chebulinic Acids. By S. R. Sunthankar and S. K. K. Jatkar. Pp. 189-208. 1.8 rupees. Vol. 21A, Part 19: Electrometric Titration of Tannic Acids. Part 2: Electrometric Titration of Gallic and Gallotannic Acids. By S. R. Sunthankar and S. K. K. Jatkar. Pp. 209-222. 1.2 rupees. Vol. 21A, Part 20: Equilibrium in Electrodeless Discharge. Part 5: Equilibrium in the Dissociation of Oxygen and in the Formation of Ozone in Silent Electric Discharge. By R. Krishnan and S. K. K. Jatkar. Pp. 223-236. 1.2 rupees. Vol. 21A, Part 21: Adsorption of Gelatin by Precipitated Hydroxides. By J. G. Kane. Pp. 237-244. 12 annas. (Bangalore: Indian Institute of Science.) [1810